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C&SF RESTUDY ALTERNATIVE EVALUATION TEAM REPORT ON THE PLAN FORMULATION ALTERNATIVE 2

Prepared by the C&SF Restudy Alternative Evaluation Team

Introduction

The Central and Southern Florida (C&SF) Project Restudy created an Alternative Evaluation Team (AET) for the purpose of evaluating the effects from a number of alternative plans, as a basis for developing the Comprehensive Plan for the C&SF Project. The objective of the AET evaluation process is to identify the plan (or plans) which best meets the regional restoration and sustainability goals set by the authorizing legislation for the C&SF Project, and the Conceptual Plan of the Governor's Commission for a Sustainable South Florida. The optimum components in a Comprehensive Plan are identified by means of an iterative evaluation process, whereby different combinations of these components are sequentially modeled and evaluated relative to a set of pre-determined performance measures. Components which substantially improve on base conditions, or which meet performance targets, are carried forward in the iterative modeling and evaluation process, while components which fail to perform well may be modified or rejected.

The AET is an ad hoc team, established by the Restudy for the specific purpose of evaluating a large number of alternative plans during a definitive planning process. The plan evaluation process is scheduled for September 1997 through April 1998. This report presents a summary of the conclusions of the third plan evaluation meeting of the AET, held January 5-6, 1998. At this meeting, the AET evaluated the Alternative 2 model simulation (summarized below). The core of this report is a set of evaluations conducted by ten subregional and issue subteams of the AET, relative to Alternative 2, and recommendations from these subteams and the full AET for improvements in performance required during subsequent plan simulations. This report also includes recommendations for improvements in the plan evaluation process, for incorporation in future evaluation cycles.

Methods

The AET is a multi-agency, multi-disciplinary team, consisting of about 30 members. The AET is divided into ten subregional and issue subteams, each with a chair or co-chairs (Kissimmee/Lake Okeechobee, Lake Okeechobee Service Area, Lower East Coast, Northern / Central Everglades, Southern Everglades, Estuaries and Bays, Big Cypress, Total Systems, ATLSS / Threatened and Endangered / Keystone Species, and Water Quality). During each evaluation cycle, each subteam has the lead responsibility for collecting all evaluations submitted to the AET from any non-AET source, which are applicable to the subregion and issues being

addressed by that team; additionally, each subteam performs its own evaluations. The subteams synthesize all evaluations into subteam reports to the full AET during each evaluation cycle.

Plan evaluations conducted by the subteams and the full AET are based on, (1) a set of pre-determined, hydrological performance measures, and (2) output from landscape-scale, ecological and water quality models. Each performance measure identifies specific hydrological targets, based on ecological, water supply, flood control and water quality objectives established for the C&SF Restudy. These hydrological targets have been defined in large part through the development of a suite of conceptual ecological models for the south Florida wetland landscapes, the draft Lower East Coast Regional Water Supply Plan, and the Lake Okeechobee Regulation Schedule Study. Performance measures may be added or deleted from the set used by the AET, based on recommendations from the subteams and approval by the full AET. Each alternative plan is evaluated based on the success of that plan in meeting the targets established by the performance measures. The hydrological performance of each plan is reported on the public web site during each evaluation cycle.

In addition to the performance measures, the AET may use output from three landscape scale models, the Across Trophic Level System Simulation model (ATLSS), the Everglades Landscape Model (ELM), and the Everglades Water Quality Model (EWQM). These models will be used to compare effects from alternative plans against either the current base (1995) or future "without project" base (2050). Summaries of output from these models, as it becomes available to the AET, will be reported in the AET evaluation reports.

Evaluations submitted by a subteam to the full AET, whether originating from the subteam or from an outside evaluator, are framed within the context of one or more performance measures. The full AET, during its meeting, synthesizes the subteam evaluations into a set of summary, "highlights" statements. These highlights statements are intended to describe the major strengths and weaknesses of the plan under current review, relative to the targets set by the performance measures. The highlights statements are provided to the Alternative Development Team (ADT) as a basis for designing the next alternative plan.

In addition to the brief, highlights report, the AET prepares a written report of each evaluation cycle. The written reports include short narrative summaries from each subteam, a list of the performance measures used by the subteams during that evaluation cycle, and recommendations for future plans and to the evaluation process.

Evaluation of Alternative 2

Plan Components

The following components are those which were included in the Alternative 2 hydrologic simulation by the South Florida Water Management Model (SFWMM). A more detailed description of the alternative can be found on the Restudy web site (www.restudy.org), Comprehensive Plan Evaluation, Alternatives Description / Evaluation.

Component A1. A Storage Reservoir (20,000 acres at 10' maximum depth) north of Lake Okeechobee.

Component B2. A Storage Reservoir (10,000 acres at 4' maximum depth) in the St. Lucie basin.

Component C1. Environmental Water Supply Deliveries to the St. Lucie Estuary (operational change only).

Component D2. A Storage Reservoir (20,000 acres at 8' maximum depth) with Aquifer Storage and Recovery (22 10-MGD wells) in the Caloosahatchee basin.

Component E1. Environmental Water Supply Deliveries to the Caloosahatchee Estuary (operational change only).

Component F1. Current Lake Okeechobee Regulation Schedule (with the exception of all but Zone A [emergency] regulatory releases to the St. Lucie Estuary).

Component G2. A Storage Reservoir (40,000 acres at 6' maximum depth) in the Everglades Agricultural Area with increased conveyance from Lake Okeechobee to the reservoir.

Component H2. Everglades Rain-Driven Operations (Draft Lower East Coast Regional Water Supply Plan Alternative 5 Operational Rules for deliveries to the Water Conservation Areas and Everglades National Park with the addition of triggers for Northeast Shark River Slough).

Component I1. Improved Conveyance between Water Conservation Area 3B and Everglades National Park (two additional S-355 structures).

Component J. Not included in Alternative 2.

Component K2. Water Preserve Areas / L-8 Project Phase II in northern Palm Beach County – modified from Alternative 1 to capture additional water and improve stages in the West Palm Beach Water Catchment Area.

Component L2. Change Coastal Wellfields Operations in the Lower East Coast Service Area.

Component M1. Water Preserve Areas / Site 1 (1,660 acre at 6' maximum depth) in western Palm Beach County.

Component N2. Water Conservation Area 2B Levee Seepage Management in Broward County to manage only wet season seepage.

Component O1. Water Conservation Area 3A and 3B Levee Seepage Management in Broward County.

Component P2. Water Preserve Areas / North New River Diversion Canal and Treatment Facility (1,600 acres at 4' maximum depth north of C-11) in Broward County with increased pump and structure capacities and seasonal S-141 operations.

Component Q1. Water Preserve Areas / Western C-11 Diversion Canal (to Central Lake Belt Storage) in Broward County.

Component R1. Water Preserve Areas / C-9 Impoundment (2,500 acres at 4' maximum depth) in Broward County.

Component S1. Central Lake Belt In-ground Storage Reservoir (~10,000 acres) in Dade County.

Component T1. C-4 Structure in Dade County.

Component U2. Water Preserve Areas / Bird Drive Impoundment (2,877 acre at 4' maximum depth) in Dade County with operational rules for the C-4 downstream diversion structure.

Component V2. L-31N Levee Improvements for Seepage Management in Dade County with additional reduction of seepage in the wet season.

Component W2. Taylor Creek / Nubbin Slough Storage and Treatment Area (5,000 acre storage area at 10’ maximum depth and 5,000 acre stormwater treatment area at 4’ maximum depth).

Component X2. Water Preserve Areas / C-17 Backpumping in North Palm Beach Service Area (308 acre stormwater treatment area at 4’ maximum depth).

Component Y2. Water Preserve Areas / C-51 Backpumping to Water Catchment Area in Palm Beach County (1,800 acre stormwater treatment area at 4’ maximum depth).

Component AA2. Additional S-345 Structures in L-67A in Water Conservation Area 3B.

Component BB1. Improvement to Dade-Broward Levee and Associated Conveyance System in Dade County.

Component CC2. Broward County Secondary Canal System (increase pump capacity and canal conveyance in C-13).

Component DD2. Revised Holey Land Operational Plan in Palm Beach County.

Alternative 2 Highlights

The following highlights represent the major strengths and weaknesses of Alternative 2, as evaluated by the AET:

AET TOP 11 PROBLEMS FOR ADT TO ADDRESS

1. Reduce Lake Okeechobee Service Area supply-side management cutback events.
2. Reduce lake-triggered water shortages in Lower East Coast Service Areas.
3. Reduce extreme number of local well-triggered events in Service Area 2.
4. Reduce C-9 saltwater intrusion.
5. Redirect water going NE WCA-3A to NW WCA-3A to improve hydroperiod.
6. Direct any amount of water possible into Northeast Shark River Slough from north.
7. Address Biscayne Bay problem, re: surface water heads in Model Lands and ground water moving to the east.
8. Address attenuating high water events in WCAs during high water years.
9. Answer the question: In to order to fix the whole system, what amount of water is needed and how much is there in the system to achieve restoration? (What volume are we short, if any?).
10. Fix regulatory releases to the estuaries.
11. Add Aquifer Storage & Recovery (ASR) in Lake Okeechobee.

A. Total System

Problem: Hydroperiods still need to be improved in all the WCAs and ENP, particularly WCA-2B, WCA-3A north, WCA-3B, Rotenberger, Holey Land and Pennsuco wetlands.
Problem: NSM ponding depths in Rotenberger and the Park need to be maintained while improving those in the WCAs.
Problem: Continue to correct the extreme long and short hydroperiods in the WCAs while improving hydroperiods in greater areas.
Problem: Increase the number of acres with the longest hydroperiods in line with NSM predictions to support apple snails and snail kites.

B. Kissimmee / Lake Okeechobee

Performance Measure: Frequency of extreme high (>17 ft) lake stage events.
Goal: No events.
Problem: Under all scenarios evaluated to date, the lake displayed a greater range of maximal water depths than is optimal for a healthy ecosystem. Lake levels exceeded 17 ft on four occasions.

Performance Measure: Frequency of extreme low (<11 ft) lake stage events.
Goal: No events.

Problem: Under all scenarios evaluated to date, the lake displayed a greater range of minimum water depths than is optimal for a healthy ecosystem. Lake levels fell below 11 ft on ten occasions.

Performance Measure: Duration of moderately high (>15 ft) lake stage events.
Goal: No prolonged (>6 months) events of this type.
Problem: Under the alternatives evaluated to date, there were three events wherein lake stage exceeded 15 ft for over 1 year. Events of this nature damage submerged plant communities and fisheries, and impair water quality.

Performance Measure: Duration of moderately low (<12 ft) lake stage events.
Goal: No prolonged (>6 months) events.
Problem: The median duration of <12 ft lake stage events, as well as the maximal duration of such events, exceed restoration goals. Conditions were actually worsened under Alternative 2, as compared to the previous alternatives, with six such events.

C. Lake Okeechobee Service Area

Performance Measure: Supply-Side Management Report.
Goal: To meet all water needs. The State's water supply planning goal is to meet demands in a 1 in 10 year drought (frequency goal). The severity goal for the water supply shortages is under development.
Problem: Alternative 2 results show the LOSA is in supply-side management with cutbacks for 16 of the 31 years, providing a 1 in 2 year level of service. 1995 Base results have supply-side management with cutbacks occurring in 15 of the 31 years. The 1995 Base conditions are not the goal. Additionally, the duration and severity of the cutbacks have increased in Alternative 2 (12 phase 4 events/1269 days, 1 phase 3/71 days, 1 phase 2/19 days, and 2 phase 1/46 days) as compared to the 1995 Base (7 phase 4 events/810 days, 4 phase 3/293 days, 2 phase 2/45 days, and 2 phase 1/17 days).
Note: The LOSA was in supply-side management in 1974 and 1975, and the LEC Service Areas were not in a lake-triggered water shortage event. Why is that?

Performance Measure: Simulated Demands Not Met due to Water Restrictions per Year in LEC Service Areas.
Goal: To meet all water needs. The State's water supply goal is to meet demands in a 1 in 10 year drought (frequency goal). The severity goal for the water supply shortages is a phase 1 event (15% cutback).
Problem: Alternative 2 shows five Lake Okeechobee-triggered water shortage events in each of the Lower East Coast Service Areas (1972-72, 1976, 1977, 1982, 1990-91). This is an improvement over the 2050 Base, but two of the events should be eliminated.

D. Lower East Coast

Water Supply:

Performance Measure: Number of Times of Simulated Water Supply Cutbacks triggered by Lake Okeechobee for the 1965-1995 Simulation Period for the LECSA.
Goal: 1 in 10 level of certainty.
Problem: While Alternative 2 is an improvement over the 2050 Base, Starting Point, and Alternative 1, it shows little to no improvement over the 1995 Base nor is the 1 in 10 level of certainty met for the entire LECSA. The number shortages triggered by Lake Okeechobee stages is unacceptable for all of the LECSA (13-16 times for each SA).
Improvement Needed: Reduce the number of local ground water and Lake Okeechobee triggered cutbacks to 1 in 10 level of certainty (no more than three events for period of record).
Recommendations: Perhaps the ADT could combine ASR with a modified regulation schedule. The ADT needs to look at alternative sources of water for the EAA. Perhaps ASR could be more appropriate for the EAA, while the water supplied by reservoirs could be used for LEC deliveries. Remove, or alter the Lake Okeechobee trigger for LEC cutbacks since the dependence of the LECSA on average annual deliveries from the regional system generally declines across the alternatives compared to the 1995 Base.

Problem: Riviera Beach still experiences a high number of cutbacks (eight times).
Performance Measure: Number of times of simulated water supply cutbacks triggered by local ground water levels for the 1965-1995 simulation period for LECSA.
Goal: One in ten year level of certainty for water supply.
Improvement Needed: Reduce the number of local ground water and Lake Okeechobee triggered cutbacks to 1 in 10 level of certainty (no more than three events for period of record).
Recommendation: Adding ASR to L-8 option would improve flows and recharge.

Problem: The number and duration of locally triggered cutbacks is unacceptable in SA2 due to Hollywood (45 times, approximately 12% of the time) and Ft. Lauderdale Airport (31 times). In addition, there are 16 Lake Okeechobee triggered events for SA2.
Improvement Needed: Reduce the number of local ground water and Lake Okeechobee triggered cutbacks to 1 in 10 level of certainty (no more than three events for period of record).
Recommendations: For Hollywood; shift 31MGD of demand to South Broward County Regional Wellfield, Floridan remains at 4 MGD, demand from 3A shifts to South Broward County Regional Wellfield, shift all of Dania and Hallandale's demand to South Broward County Regional Wellfield (variation of component L2). Provide surface water recharge to Dixie-Peele Wellfield from the canal east of the turnpike which leads to the C-12 (control structure is just north of Broward Blvd). The pumps and canal capacities will need to be improved and expanded. The ADT needs to improve management of WCA-3B. The water is piling up behind the seepage control structure and not providing any benefits. The ADT needs to either add seepage to send ground water south and east to recharge wellfields and canals or move it south to ENP. Although Pompano is not causing any local triggered cutbacks, it does experience saltwater intrusion problems in the wellfields. The easternmost pumpages should be moved to the North County Regional Wellfield in Alternative 3.

Problem: The number and duration of locally triggered cutbacks is unacceptable in SA3 due to Homestead (17 times), Florida City (two times) and Taylor (four times). In addition, there are 16 Lake Okeechobee triggered events for SA3. This is greater than the 1995 Base and Alternative 1.
Improvement Needed: Reduce the number of local ground water and Lake Okeechobee triggered cutbacks to 1 in 10 level of certainty (no more than three events for period of record).

Recommendations: Fill in C-111 from S-18C south and add a spreader canal east from S-18C. This may reduce losses from the canal system and increase deliveries to the Model Lands. Maintaining flood control may need to be reviewed carefully. Modify the levee seepage control along L-31N and remove the curtain wall around the central lake belt storage or move the reservoir north. (See recommendations for Central Lake Belt Reservoir.)

Canal Levels:
Performance Measure: Saltwater intrusion.
Goal:
Problems: In the NPBC, all canal levels meet or exceed the salt-water intrusion criteria. In SA1, **a**ll canal levels meet or exceed the saltwater intrusion criteria. In SA2, using the % of Time Canal Stage < Salt-Water Intrusion Criteria and Occurrences > 1 Week - C-14 at S-37B and North New River @S-54, the performance measure meets or exceeds criteria in Alternative 2. In SA2, using the % of Time Canal Stage < Salt-Water Intrusion Criteria and Occurrences > 1 Week - C-9 at S-29, Alternative 2 shows an increase in the number of saltwater intrusion trigger events relative to Alternative 1. The canal is below minimum level 17% of the time (~4.5+ years). This indicates that ground water levels are somewhat lower than in Alternative 1, which also means that the ground water deliveries to Biscayne Bay would be less than in Alternative 1. This alternative is, therefore, worse than Alternative 1 with respect to conditions in Biscayne Bay. The lower canal stages are also impacting the Hollywood local ground water trigger, which triggered shortages 45 times in the period of record. The link between canal stages and local ground water triggers is strongest when the canal drops below two feet.
Note: The stage duration curves show that approximately half of the time, ground water levels for all alternatives are at a height which is at or just above the saltwater intrusion trigger level. Both the 1995 Base and 2050 Base have ground water levels that more than half of the time are at least a few inches higher than the salt intrusion triggers. The difference of a few inches in hydraulic head may be sufficient to provide more freshwater deliveries to the bay via ground water and the aquifer near the Hollywood wellfields. Alternatives that support higher ground water levels to prevent saltwater intrusion and trigger shortages are absolutely necessary.
Improvement Needed: Meet or exceed the minimum level to prevent saltwater intrusion in the C-9 all the time. The ADT needs to hold more water longer in the canals and restore wet season flows. The lack of ground water seepage cannot be overcome by surface water canal deliveries.
Recommendations: Reduce the block on ground water seepage at the bottom of WCA-2B. Send more flows east instead of south to the Water Preserve Area (Lakebelt). Increase structures and pumps on L-31N between Kendall Drive and Tamiami Trail to control water levels. Develop ASR from C-1 south to ENP entrance (S-177) to meet local water supply needs and to provide recharge to canals in the dry season.

Problems: SA3: For C-6 at S-26 Alternative 2 shows an increase in the number of saltwater intrusion trigger events relative to Alternative 1. The canal is below minimum level 9% of the time. For C-4 at S-25B Alternative 2 shows an increase in the number of saltwater intrusion trigger events relative to Alternative 1. The canal is below minimum level 13% of the time. For C-2 at S-22 Alternative 2 shows an increase in the number of saltwater intrusion trigger events relative to Alternative 1. The canal is below minimum level 11% of the time.
Note: This indicates that ground water levels are somewhat lower than in Alternative 1, which also means that the ground water deliveries to Biscayne Bay would be less than in Alternative 1. This

alternative is, therefore, worse than Alternative 1 with respect to conditions in Biscayne Bay. The seepage mechanism on the L-31N appears to be affecting the C-4 and C-2 and may also affect the West Wellfield. Deliveries and recharge to the canals and wellfield should be maintained. The stage duration curves show that approximately half of the time, ground water levels for all alternatives are at a height which is at or just above the saltwater intrusion trigger level. Both the 1995 Base and 2050 Base have ground water levels that more than half of the time are at least a few inches higher than the saltwater intrusion triggers. The difference of a few inches in hydraulic head may be sufficient to provide more freshwater deliveries to the bay via ground water.
Improvement Needed: Meet or exceed the minimum level to prevent saltwater intrusion on primary canals all the time. The ADT needs to hold more water longer in the canals and restore wet season flows. The lack of ground water seepage cannot be overcome by surface water canal deliveries.
Recommendations: Reduce the 100% block on ground water seepage as described in component V2. Increase the use of ASR on Snake Creek and Miami River. Develop ASR along L-31N from C-1 south to ENP entrance (S-177) to meet local water supply needs and to provide recharge to canals in the dry season. Increase structures and pumps on L-31N between Kendall Drive and Tamiami Trail to control water levels and divert to primary canals as necessary to maintain levels. One structure on the L-31N is being considered as a Critical Project. Additional structures may be useful.

Reservoirs:
Notes: Bird Drive Reservoir: As mentioned in the comments on Alternative 1, the surface elevation portrayed in this performance measure is questionable since it shows 1995 Base levels exceeding surface only approximately 1% of the time. Field observations indicate that there is surface water in this portion of the Bird Drive Basin approximately two to three months out of the year, which equates to approximately 20% of the time. Using inadequate surface elevations results in under reporting the water supply provided by this basin under current conditions. There is a need to correct how the component operates and how the model is calibrated for this area. There is also a need to address water quality concerns. This facility is located within the West Wellfield Interim Protection Area and, therefore, only water of the appropriate quality should be back pumped into this facility.

Notes: Central Lakebelt In-ground Storage Reservoir: The area proposed for the storage reservoir is located within the wellfield protection area of the Northwest Wellfield which supplies water to businesses and residents north of Tamiami Trail. Miami-Dade County has implemented an extensive wellfield protection program to minimize risks to that water supply. While in theory a subterranean seepage barrier should not leak, reality could prove otherwise and it would be difficult to support assuming such a risk to the current high quality of water withdrawn from that wellfield. Therefore, water pumped into the reservoir would have to meet appropriate water quality standards and concomitantly may require treatment. Additionally, the Lakebelt In-ground Storage Reservoir will affect the cone of influence of the Northwest Wellfield by shifting it further east and into industrially developed areas north of Tamiami Trail. The ADT needs to create a component that is feasible, does not compromise ground water quality, does not impact the cone of influence for the Northwest Wellfield, and does not impact the Pennsuco wetlands.
Recommendations: As an alternative to the Central Lakebelt In-ground Storage Reservoir, DERM recommends that the Restudy consider, in Alternative 3, locating this storage reservoir and an

associated storm water treatment area in the C-9 Basin south of the C-9 canal. A significant portion of this area was approved for rock mining by the Lakebelt Issue Team and is being actively mined. Rock mining companies own 4,800 contiguous acres in the area. Additionally, there is one square mile of publicly owned land bordering the south side of the C-9 canal, which could potentially be used for a storm water treatment area.

Water Deliveries:
Note: Water supply deliveries to SA2 increase modestly for Alternative 2 during drought years (76k ac/ft) when compared to average annual deliveries (42k ac/ft) which may be impacting Hollywood and Ft Lauderdale Airport triggers. Other service areas have much greater deliveries, both annual average and during drought years. SA1 has 119k ac/ft on average, 213k ac/ft during drought years - an increase of 100k ac/ft; while SA3 has 80k ac/ft delivered on average and 248k ac/ft during drought years - a dramatic increase.
Improvement Needed: Reduce the number of local ground water and Lake Okeechobee triggered cutbacks to a 1 in 10 level of certainty (no more than three events for the period of record).
Recommendations: The ADT needs to increase deliveries to SA2 during drought years (or increase ground water seepage).

Note: In Alternative 2, Average Annual Deliveries from Lake Okeechobee and the WCA to SA3 increase when compared to Alternative 1, yet the canal stages are still below the saltwater intrusion criteria for the canals; flows to Biscayne Bay are still too low (even lower than 1995 Base). The deliveries in Alternative 2 decline when compared to the 1995 Base.
Improvement Needed: Reduce the number of local ground water and Lake Okeechobee triggered cutbacks to a 1 in 10 level of certainty (no more than three events for the period of record).

Flood Protection:
Performance Indicator: Stage Hydrographs for five indicator cells in western Miami-Dade.
Problem: Levels in cells R10C25, R17C27, R13C25, R15C26 indicate an increase in flooding potential when comparing Alternative 2 to the 1995 Base, 2050 Base, and Starting Point. The 2 foot root zone is exceeded 21 to 62 times for these cells.
Improvement Needed: Capture enough seepage to avoid exceeding the 2 foot root zone during the growing season while not diminishing flows to Biscayne Bay.
Recommendations: Capture seepage from L-31N moving from ENP east into the agricultural areas. Develop ASR from C-1 south to ENP entrance (S-177) to meet local water supply needs and to provide recharge to canal in the dry season. The ADT needs to modify how C-111 and Modified Water Deliveries Projects are being simulated. By modifying the 2050 Base, the flooding caused by the current simulated operating plans may be eliminated.

Problem: Stage Hydrographs for R19C27 indicate a decrease in flooding potential when comparing Alternative 2 to the 1995 Base. However, the 2 foot root zone is exceeded 57 % of the time.
Improvement Needed: Avoid exceeding the 2 foot root zone during the growing season.

E. Northern / Central Everglades (WCAs, Holey Land, Rotenberger)

Holey Land WMA:

Performance Measure: Inundation Duration.
Goal: Match NSM.
Results: Okay. Alternative 2 is similar to NSM and improved (= reduced) over 2050 Base.

Performance Measure: Extreme High Water.
Goal: Minimize exceedence of NSM highs and of high criterion.
Problem: Alternative 2 is too deep for too long. In the wettest years depths exceed 2.0 ft and exceed NSM peak stages by more than 1.0 ft, both for extended periods. On ~10 occasions depths stayed >1.5 ft for nearly a year. (Above 1.5 ft all upland refugia in Holey Land are under water.)

Performance Measure: Timing of Depth Variation.
Goal: Match NSM timing.
Problem: Alternative 2 exceeds NSM by about 0.3 ft deeper year round. This is slightly less (~0.1 ft) than mean depths in the 2050 Base but approximately 0.5 ft deeper than the 1995 Base.
Improvement Needed: Reduce depths by ~0.3 ft year round, without increasing the frequency of drying below -1.0 ft.
Recommendations: Include structures along south boundary to allow for removal of water during wet periods. Use operational rules to trigger releases from Holey Land.

Rotenberger WMA:
Performance Measure: Inundation Duration.
Goal: Match NSM.
Problem: The average hydroperiod is three weeks longer than NSM (84% vs. 79%), with fewer dry-outs and longer periods of flooding. This is similar to the 2050 Base (hydroperiod=86%) and much wetter than 1995 Base (hydroperiod=58%).

Performance Measure: Extreme High Water.
Goal: Minimize exceedence of NSM highs and of high criterion.
Problem: Depths exceed 1.5 ft ~18% of time in Alternative 2 but only ~7% of time in NSM. Depths >2.0 ft occur about twice as often as in NSM. Alternative 2 peak depths are similar to the 2050 Base but much higher than the 1995 Base.

Performance Measure: Timing of Depth Variation.
Goal: Match NSM timing.
Improvement Needed: Wet season depths not to exceed 1.5 ft, which is recommended for protection of remaining tree islands that have been damaged by fire and to reduce opportunities for cattail proliferation.
Problem: Alternative 2 timing is similar to NSM but water is about 0.3 ft deeper year round. This is slightly shallower than the 2050 Base but ~1.0 ft deeper than the 1995 Base.
Recommendations: Rotenberger needs a small reduction in hydroperiod (~5%) and ~0.25 ft reduction in average depths year round, with no increase in the frequency of drying below -1.0 ft. Include structures along the south boundary to allow for removal of water during wet periods. Use operational rules that trigger releases from Rotenberger when NSM or 0-1.0 ft regulation schedule is exceeded.

Loxahatchee National Wildlife Refuge (WCA-1):
Performance Measure: Extreme High Water.
Goal: Under development.
Problem: In the southern refuge (Region 26), depths exceed 2.5 ft ~ 20% of time during a total of ~8 events. This is a reduction of 10% of time compared with the 1995 Base, but no change from the 2050 Base. NSM never exceeds 2.5 ft in this area. (Note: the 2.5 ft high water criterion is the only performance measure for LNWR that has received input from refuge staff.)
Improvement Needed: During December, ADT members spoke with refuge staff and were told that they desire no change to LNWR hydrology other than what is already included in the 2050 Base condition.
Recommendation: Develop rainfall-based operational rules, while avoiding water quality effects in central LNWR. For Alternative 4, include the Southern Everglades subteam's plan components.

WCA-2A:
Performance Measure: Inundation Duration.
Goal: Match NSM.
Problem: A little short. In the north (Region 25), inundation periods are fewer than NSM but of longer duration, while in the south (Region 24), they are more numerous but shorter. Overall, Alternative 2's average hydroperiod is 3-5% shorter than NSM and similar to the 2050 Base.

Performance Measure: Extreme High Water.
Goal: Minimize exceedence of NSM highs and of high criterion.
Problem: In the south, peak depths exceed 2.5 ft during several of the wettest years; NSM does not exceed 2.5 ft. Alternative 2 is similar to the 2050 Base and deeper than the 1995 Base.

Performance Measure: Extreme Low Water.
Goal: Minimize exceedence of NSM lows and of low criterion.
Problem: In both the north and south, depths go below -1.0 ft and also below NSM minima on several occasions. There is little change from the 2050 Base, but lows are not as extreme as in the 1995 Base.

Performance Measure: Timing of Depth Variation.
Goal: Match NSM timing.
Problem: In the north, water rises earlier in the wet season and recedes faster in the dry season than in NSM. In the south, the mean wet season high is ~ 0.3 ft higher than NSM but mean dry season low is ~0.2 ft lower than NSM; this pattern is similar to the 2050 Base but somewhat deeper than the 1995 Base. Year-to-year standard deviation is ~1.5x that of NSM during the dry season in the north and all year in the south; hence, annual depths are much less predictable than NSM.
Improvement Needed: Better timing and a "flatter" stage duration curve, especially in the south. This includes: (1) reduced wet season highs; (2) increased dry season lows; and (3) a modest (~ 5%) increase in hydroperiod.
Recommendations: Additional regional storage (EAA) could provide both wet season/wet year flood attenuation as well as dry season supply. Improve operational triggers.

WCA-2B:
Performance Measure: Inundation Duration.
Goal: Match NSM.
Problem: Too short. Alternative 2's average hydroperiod is six weeks (11%) shorter than NSM. This is similar to the 2050 Base.

Performance Measure: Extreme High Water.
Goal: Minimize exceedence of NSM highs and of high criterion.
Problem: Wet season average high is ~ 1.5 ft deeper than NSM, although somewhat improved over the 2050 Base (~0.3 ft lower). Wet year depths exceed 2.5 ft for very long periods, and exceed 5.0 ft in highest water years.

Performance Measure: Extreme Low Water.
Goal: Minimize exceedence of NSM lows and of low criterion.
Problem: Dry year lows are lower than NSM minima by as much as 1-2 ft; lows <-1.0 ft occur in ~9 years.

Performance Measure: Timing of Depth Variation.
Goal: Match NSM timing.
Problem: Year-to-year standard deviation is ~ 2.5 to 3 times that of NSM.
Improvement Needed: Reduced depths and better timing (a "flatter" and much lower stage duration curve). This means: (1) reduce wet year peaks about 2.5 ft; (2) reduce average wet season highs about 1.5 ft; (3) increase dry year low depths about 1.0 ft; (4) increase hydroperiod about 10%; and (5) only if all else fails, use part of WCA-2B for seepage control.

Note: Query to modeling team. There is a need to check for accuracy of model output in WCA-2B; as the 1995 Base appears to be too deep.
Recommendations: Install a water control trigger in WCA-2B. Convey wet season water to the west and south. Increase seepage control for dry season losses or increase deliveries. Only if all else fails, use part of area for seepage control.

Northwest WCA-3A (north of Alligator Alley; west of Miami Canal; Indicator Regions 20 and 22):
Performance Measure: Inundation Duration.
Goal: Match NSM.
Problem: A little short. Alternative 2's average hydroperiod is 2-4 % shorter than NSM (89% vs. 93% in Region 20, 92% vs. 94% in Region 22). There is little change from the 2050 Base but about a 9% increase in hydroperiod over the 1995 Base.

Performance Measure: Extreme Low Water.
Goal: Minimize exceedence of NSM lows and of low criterion.
Problem: Too many events. Region 20 has ~8 more events with depths <-1.0 ft and minima are lower than in NSM. Region 22 is similar but less severe in predicted drying. Alternative 2 is similar to the 2050 Base but is much less dry than 1995 Base.

Performance Measure: Timing of Depth Variation.
Goal: Match NSM timing.
Problem: Wet season depths drop faster than NSM to a mean low that is ~0.5 ft less than NSM in Region 20 and ~0.1 ft less than NSM in Region 22. This is a very slight improvement relative to the 2050 Base.
Improvement Needed: Dry season minima should be increased by about 0.5 ft to protect peat soils. Wet season depths could be sustained longer and possibly increased slightly (~0.2 ft).
Recommendations: Convey excess late wet season water from eastern WCA-3A to northwest WCA-3A. Provide more EAA storage to maintain dry season depths.

Northeast WCA-3A (north of Alligator Alley; east of Miami Canal; Indicator Region 21):
Performance Measure: Inundation Duration.
Goal: Match NSM.
Problem: The average hydroperiod is 7% longer than NSM (Alternative 2 = 91% vs. NSM = 84%). This is slightly wetter than the 2050 Base (89%) and much wetter than the 1995 Base (74%).

Performance Measure: Extreme High Water.
Goal: Minimize exceedence of NSM highs and of high criterion.
Problem: During the high water year of 1994, Alternative 2 exceeded 2.5 ft in depth whereas NSM did not. This is similar to the 1995 and 2050 Base performances.

Performance Measure: Extreme Low Water.
Goal: Minimize exceedence of NSM lows and of low criterion.
Problem: Alternative 2 depths are below -1.0 ft ~4% of the time. Although NSM is below -1.0 ft more often (~7%), it is desirable to minimize extreme drying in this region to protect peat soils from further oxidation.

Performance Measure: Timing of Depth Variation.
Goal: Match NSM timing.
Problem: Dry season average depths exceed NSM by ~0.5 ft, similar to the 2050 Base and 1995 Base.
Improvement Needed: Reduce dry season depths by about 0.25 ft, but avoid increasing the frequency of drying below -1.0 ft. Prevent infrequent but unnatural high water levels such as those seen in 1994-95. This region contains one of the Everglades' most productive wading bird rookeries in recent years, which may have lost as much as 75% of its willows during the 1994-95 high water.
Recommendations: Redirect late wet season water to western WCA-3A (see above). Increase regional storage to attenuate flood year peaks and to provide dry year minimum flows.

East WCA-3A (south of Alligator Alley; east of Miami Canal; Indicator Region 19):
Performance Measure: Inundation Duration.
Goal: Match NSM.
Problem: Too long. The average hydroperiod is 9% longer than NSM (Alternative 2 = 97% vs. NSM = 89%). Although an improvement over the even wetter 1995 Base (hydroperiod = 99%), this is a change in the wrong direction compared to the 2050 Base (hydroperiod = 95%).

Performance Measure: Extreme High Water.
Goal: Minimize exceedence of NSM highs and of high criterion.
Problem: Too deep. Depths exceed NSM year round. Wet season depths average ~ 1.0 ft higher than NSM, and in the wettest years exceed NSM by up to 2.0 ft. Wet season depths >2.5 ft occur several times. This performance is similar to both the 2050 Base and 1995 Base.
Improvement Needed: A year-round depth reduction of ~1.0 ft is needed, with greater reductions during peak wet years.
Recommendations: Reduce inflows by redirecting water to western WCA-3A. Move water south to WCA-3B via gaps in L-67 and/or by returning WCA-3A seepage to WCA-3B.

WCA-3A South (south of Alligator Alley; west of Miami Canal; Indicator Regions 14, 17 & 18):
Performance Measure: Inundation Duration.
Goal: Under development.
Problem: Average hydroperiods match NSM. However, in Region 17 the NSM hydroperiod appears to be too short for a ridge and slough landscape (89%); thus by matching NSM, Alternative 2 over-drains this area. Alternative 2 is similar to the 2050 Base throughout southern WCA-3A and is much drier than the 1995 Base.

Performance Measure: Extreme High Water.
Goal: Under development; avoid exceedence of high criterion.
Problem: Wet season depths in the south (Region 14) exceed NSM during the wettest years and exceed 2.5 ft on ~ 5 occasions. During the 1994-95 high water period, Alternative 2 sustained depths of 3-5 ft in all three indicator regions, whereas NSM never exceeded 2.5 ft except briefly in Region 14 in 1994. This is of concern since it takes no more than a single sustained high-water event to do major, and possibly lasting, damage to tree island and tropical hammock vegetation.

Performance Measure: Extreme Low Water.
Goal: Under development; avoid exceedence of low criterion.
Problem: Region 17 dries out to <-1.0 ft about twice as long as the 1995 Base (~4% vs. 2% of time); together with Region 18, this area is the least hydrologically damaged part of the northern Everglades, so further drying should be avoided.

Performance Measure: Timing of Depth Variation.
Goal: Match NSM timing.
Problem: South WCA-3A (Region 14) averages about 0.5 ft above NSM during the wet season.
Improvement Needed: Increase depths in Region 17 by about 0.5 ft in dry season and 0.2 ft in wet season. Reduce peak stages during high water years to < 2.5 ft to avoid damage to tree island communities. Reduce ponding along northern reaches of L-67.
Recommendations: Redirect water deliveries into northern WCA-3A toward the west to reduce over-drainage of west-central WCA-3A, while reducing ponding to the east. "Rescale" the NSM triggers in WCA-3A south to pull water sooner during drying periods. Provide more EAA storage to attenuate flood waters that will otherwise end up causing unnaturally high peak stages.

Reconfigure conveyance from WCA-3A to the east and south to reduce ponding along northern L-67 and to bring down wet season depths in Region 14.

WCA-3B (Indicator Region 15):
Performance Measure: Inundation Duration.
Goal: Match NSM.
Problem: The average hydroperiod of 97% is 4% longer than NSM, 6% longer than the 2050 Base, and 2% longer than the 1995 Base, thus moving in the "wrong" direction relative to NSM.

Performance Measure: Extreme High Water.
Goal: Minimize exceedence of NSM highs and of high criterion.
Problem: Depths exceed 2.5 ft on ~10 occasions, and have higher peak stages than any of the other models in almost every year. In the north, depths exceed NSM by about 1.0 ft almost continuously. During the 1994-95 high water, depths exceeded 3-4 ft for durations of several months, which is deeper than the 2050 Base and much deeper than 1995 Base.
Improvement Needed: Reduce peak depths in northern WCA-3B by about 1.0 ft. Reduce Region 15 wet season mean depths by about 0.4 ft.
Recommendations: Fix the Tamiami Trail canal and structure system to prevent canal stages from impeding flow of water from WCA-3B. Return WCA-3B seepage to ENP.
Modeling Issue: Indicator Region 16 was not used to evaluate Alternative 2 performance because of concern about accuracy of the differences between SFWMM and NSM surface elevation assumptions. The subteam requests that the modeling team review the topography assumptions for NSM and SFWMM cells in southeastern WCA-3B and advise on (1) possible problems in comparing depths in the two models, and (2) possible effects of topography assumptions on hydrology.

Pennsuco Wetlands:
Performance Measure: Inundation Duration.
Goal: Match NSM.
Problem: The hydroperiod at R26C27 is 94%, a substantial improvement over the too-short (81%) hydroperiods of the 2050 Base and 1995 Base, but an overshoot of the NSM hydroperiod of 87%.

Performance Measures: Timing of Depth Variation.
Goal: Match NSM timing.
Problem: Alternative 2 depths continue to exceed NSM in the north and are similar to the 2050 Base.
Improvement Needed: Reduce median depths in north approximately 0.5 -0.8 ft, without reducing hydroperiod more than 5%.
Recommendation: Any suggestions?

F. Southern Everglades (Everglades National Park, Model Lands):

Northeast Shark Slough:
Problem: Under Alternative 2, the majority of overland flows are still shunted to the west rather than into the slough.

Problem: Alternative 2, like Alternative 1, is worse than the Starting Point in frequency of drydowns. As with the Starting Point and Alternative 1, Alternative 2 approaches, but still falls short of, NSM. Alternative 2 resulted in water depths that were lower overall than NSM. Under Alternative 2, the number of drydowns in NESS is nine times greater than predicted by NSM. This frequency of drydowns in the heart of the historic Shark Slough will continue to demonstrably lower standing crops and alter community composition of fishes and aquatic invertebrates and to cause loss of peat soils. *Melaleuca* expansion will continue to progress westward into the slough because of overdrainage, resulting in shorter hydroperiods.
Improvement Needed: Reduce the number of drydowns.
Recommendation: Incorporate seepage control strategies, such as buffer lands, sufficient to restore NSM-like conditions in Northeast Shark Slough.

Shark Slough:
Problem: In a dry year, NSM predicts a persistent pool aligned along the main stem of the historic Shark Slough in accordance with natural topographic contours. The pattern of dry season pooling evident in Alternative 2 (as in Alternative 1) is similar to that seen today, with dry season ponding occurring in WCA-3 and with values lower than NSM south of the Tamiami Trail. The cessation of sufficient overland flow into Shark Slough has resulted in the reduction or elimination of persistent pooling, as well as increased frequency of drydowns, affecting survival and productivity of aquatic organisms.

Question: Average monthly and annual overland flows to ENP show higher volumes of water going south of the Tamiami Trail under Alternative 2 when compared with Alternative 1. Alternative 2 also shows higher volumes of water going west of the L-67 extension canal. Why isn't more of that flow going east?

Problem: Alternative 2 consistently failed to meet NSM. Hydroperiods and flows predicted by Alternative 2 were lower than NSM. In dry years, Alternative 2 indicated that Shark Slough dried for as much as three months longer than under NSM. This would be devastating to aquatic communities.
Recommendation: Explore using the lowest management intensive strategy to establish rainfall-based flows. These flows must extend from the upper to the lower reaches of the Everglades catchment area in sufficient volume to maintain dry season pool formations that persist within the downstream reaches of the system, with hydropatterns similar to those predicted by NSM.

Rocky Glades/Eastern Marl Prairies:
Problem: Although Alternative 2, like Alternative 1, provided some improvement over the various base alternatives, it fell significantly short of restoration targets when compared with NSM. Ponding depth differences indicate a difference in Alternative 2 compared with NSM of $\pm$ 0.5 ft, whereas stage duration curves show a difference of two feet. Subsurface water levels

during the dry season are significantly lower than predicted for NSM; this has serious consequences for solution hole refugia.
Recommendations: NSM predicted relatively longer hydroperiods than the 1995 Base and both of the alternatives to date. Restoration of more natural hydropatterns in this area will result in a suite of ecological benefits for aquatic communities and endangered species. Restoration needs to provide longer continuous hydroperiods, greater ponding depths, and more frequent occurrence of multi-year continuous inundation.

Taylor Slough:
Note: The output provided for Taylor Slough was not adequate for the subteam to make an assessment of the alternative. Models runs for more stations within Taylor Slough are needed. However, there are no differences in ponding depths and average annual hydroperiods between Alternative 2 and NSM.

C-111 Basin:
Problem: Sheetflow must be reestablished in the C-111 Basin, including filling in canals, ditches, and culvert pools to reduce colonization opportunities by exotic organisms, and to eliminate artificially large, deep-water habitats that result in changes in species composition and energy flow in the adjacent wetlands. Alternative 2, like Alternative 1, shows that there are 1.5 times the number of drydown events in Indicator Region 4 as predicted by NSM. This increased frequency of drydowns has a substantial negative effect on the survival and productivity of aquatic organisms, and on associated ecological processes. Under Alternative 2, water management has eliminated the natural variability in dry season water levels apparent under NSM.
Improvement Needed: Restoration strategies for C-111 basin must reduce the frequency of drydown events as evident in Alternative 2.

Model Lands:
Problem: Water depths and hydroperiods are more than double those under NSM (for Region 6) compared with Alternative 1 and base conditions. The natural variability in stage is also eliminated under Alternative 2. All model simulation alternatives, including Alternative 2, demonstrate that the Model Lands remain hydrologically isolated, producing conditions that do not approximate NSM conditions. The basin is closed and ecologically degraded, lacking connection with adjacent wetlands to the west. The significant reduction in spatial extent of the historic natural system requires that efforts be made to restore these wetlands.
Improvement Needed: Explore strategies to improve the timing and distribution of water deliveries to the Model Lands.

General Comments on the Alternative 2 for the Central and Southern Everglades:
Note: Alternative 2 shows no substantive changes over Alternative 1 that move toward ecological restoration of the system. Alternative 2 falls short of NSM over most of the region.

Note: In the 1984 memorandum that introduced the 7-Point Plan proposed by Everglades National Park, the major recommendations for hydrologic restoration of the Shark Slough Basin included the degradation of levees and filling of canals, establishment of a rainfall-driven

system, and the reestablishment of sheet-flow. The ecological benefits of these hydrological actions included:

1. The reestablishment of connections between isolated basins to permit movement by aquatic animals, thereby reducing the isolation of populations.
2. Filling in canals and ditches to reduce colonization opportunities by exotic organisms, and to eliminate artificially large, deep-water habitats that result in changes in species composition and energy flow in the adjacent wetlands.

Note: A general assessment of Alternative 2, like Alternative 1, indicated that a number of structures (e.g., curtain walls and new structures) have been added but, conversely, the beneficial activity of the removal of structures and canals was not evident.
Recommendation: Alternative 2, like Alternative 1, did not appear to greatly advance the majority of hydrological restoration objectives promoted by the 7-Point plan, and subsequent documents. The subteam recommends that future alternatives incorporate modifications to address these concerns.

G. Estuaries and Bays

Caloosahatchee Estuary:
Performance Measure: Number of times salinity envelope criteria were not met for the Caloosahatchee Estuary.
Goal: A base flow of 300 cfs is needed to maintain appropriate salinities.
Problem: The number of times low flow discharges were not met decreased with Alternative 2, as compared to the Starting Point, 2050 Base, and Alternative 1, but the target still has not been reached.

Performance Measure: Number of times high discharge criteria (mean monthly flow > 2,800 and 4,500 cfs) were exceeded for the Caloosahatchee Estuary.
Goal: No regulatory releases from Lake Okeechobee are desired.
Problem: The number of regulatory releases to the Caloosahatchee Estuary is still high (18). However, Alternative 2 decreased the number of months that the total monthly inflow from C-43 basin exceeded 2,800 cfs and 4,500 cfs as compared to the 2050 Base, 1995 Base, Alternative 1 and the Starting Point.
Recommendations: Continue to move toward the targets of no regulatory releases as well as the low flow (<300 cfs) and high flow (>2,800 cfs) targets of 60 and 22, respectively. The Lower West Coast Planning Division of the SFWMD could provide an operational rule for a storage facility in the C-43 basin. The operational rule was developed using the Optimization model and the period of record rainfall. The stage hydrograph in C-43 basin indicates that there may be opportunities to capture more excess runoff within the basin if the reservoir could accommodate additional storage.

St. Lucie Estuary:
Performance Measure: Number of times salinity envelope criteria were not met for the St. Lucie Estuary.
Goal: A base flow of 350 cfs is needed to maintain appropriate salinities.

Problem: The increased size of the C-44 reservoir in Alternative 2 only slightly improved base flow to the estuary.

Performance Measure: Number of times high discharge criteria (mean monthly flow > 1,600 & 2,500 cfs) were exceeded for St. Lucie Estuary.
Goal: Eliminate regulatory releases and reduce high discharge (>1,600-2,500 cfs) events.
Problem: Total monthly flows to the estuary which exceed 1,600 cfs for more than 14 days cause undesirable salinity fluctuations in the estuary. Regulatory releases have been eliminated. However, the number of high discharges events were only slightly decreased with the larger C-44 reservoir incorporated in Alternative 2, as compared to Alternative 1. It appears that the influence from the other tributary basins, C-23, C-24, North Fork and South Fork overshadow the effects of the larger storage facility in the C-44 basin.
Note: Overall, Alternative 2 did not display much difference than Alternative 1 and a substantial amount of improvement is needed to attain the targets.
Recommendations: Continue moving toward meeting targets for low (<350cfs) and high (>1,600cfs) flows of 50 and 13 months, respectively. The ADT needs to look at the other tributary basins (C-23, C-24, North Fork and South Fork) to make further reductions in high discharges and to contribute towards meeting minimum base flows.

Lake Worth Lagoon:
Performance Measure: Wet/Dry Season Average Flows Discharged to Lake Worth through S40, S41 & S155 for the 31 year simulation.
Goal: Minimum flow to the Lake Worth Lagoon (150 cfs).
Problem: The C-51 performance criteria indicated that Alternative 2 slightly decreased the amount of water to Lake Worth Lagoon as compared to 2050 Base, Alternative 1, and the Starting Point.

Biscayne Bay:
Performance Measure: Simulated mean annual surface flows discharged into Biscayne Bay for the 1965-1995 simulation period.
Goal: More "estuarine" conditions.
Problem: The Starting Point reduces wet season flows to the bay by > 40% and dry season flows by > 50%. Alternative 2 provides almost the same amount of water to Biscayne Bay as in Alternative 1, except in The Miami River and Snake Creek areas. In both these areas there is a decrease of water as compared to Alternative 1. However, Alternative 2 still provides much less water than either the 2050 Base or 1995 Base. In this regard, Alternative 2 has not moved Biscayne Bay toward the goal.
Recommendations: Improve estuarine conditions by increasing water flow to Biscayne Bay. At the minimum, try and reestablish the 1995 Base flow to Biscayne Bay.

Florida Bay:
Problem: Dry season water deliveries via NE Shark River Slough are inadequate to maintain desired P33 stages of 6.3 ft and to prevent undesired high salinity events in coastal basins for 26 years of the 31-year period of record in Alternative 2.

Problem: Dry season water deliveries via NE Shark River Slough are inadequate to maintain desired P33 stages of 7.3 ft. and to attain desired low salinity events in coastal basins for six years of the 31-year period of record in Alternative 2.

Problem: Wet season water deliveries via NE Shark River Slough are inadequate to maintain desired P33 stages of 7.3 ft. and to attain desired low salinity events in coastal basins for ten years of the 31-year period of record in Alternative 2.

Problem: Wet season water deliveries via NE Shark River Slough are inadequate to maintain desired P33 stages of 6.3 ft. and to prevent undesired high salinity events in coastal basins for 15 years of the 31-year period of record in Alternative 2.

H. Big Cypress Subregion

Performance Measures and Indicators: South Florida Maps:

- Hydroperiod Distribution Maps
- Hydroperiod Improvement Maps
- Hydroperiod Differences Maps
- Ponding Depth Maps
- Ponding Depth Differences Maps
- Peak Stage Differences Maps
- Indicator Regions in or near Big Cypress (13, 31-45)
  - Weekly Stage Hydrographs
  - Weekly Stage Duration Curves
  - Temporal Variation of Stage
- Big Cypress National Preserve
  - Cells R20 C13 and R17 and C13
    - Stage Hydrographs
    - Stage Duration Curve
  - North and South Big Cypress National Preserve
    - NSM and 50B hydroperiod matches
  - Average wet/dry season flows toward Gulf of Mexico
    - western Big Cypress National Preserve
    - eastern Big Cypress National Preserve
    - Lostman's
  - Average monthly overland flows toward Gulf of Mexico
    - western Big Cypress National Preserve
    - eastern Big Cypress National Preserve
    - Lostman's

Goal: "NSM".

Problem: There are some reductions from NSM water levels along the eastern side of the Big Cypress.

Rationale: L-28 could be causing the changes in water levels in the eastern portion of the Big Cypress. Given the ponding that currently exists in the lower end of WCA-3A, removal of L-28 would probably increase water levels in the adjacent Big Cypress more than would be considered

desirable. However, changes scheduled to be made by 2050, suggest that this ponding will no longer exist at that time. Thus, removal or at least opening portions of the L-28 at that time could provide more natural water flows through the Big Cypress.
Recommendation: Eliminate or create openings in the L-28 to allow unimpeded exchange.

Problem: There appear to be inconsistencies with available ecological information as regards the hydroperiods in the westernmost two (three?) columns of cells in the Big Cypress that are generated by the models, particularly the NSM.
Rationale: The current and historic plant communities in this area could not exist with the indicated hydroperiods.
Recommendation: Try to determine what is causing the problem.

Problem: There appear to be large areas of northern Big Cypress National Preserve that have major differences in hydroperiod from that predicted by the NSM.
Rationale: The causes of these differences could result from problems with the model or effects of hydrologic alterations in the area.
Recommendation: Try to determine whether there is any basis for suspecting problems with the model, and assess upstream land uses to determine if they could be affecting the hydrology of this area. If there are significant upstream effects, try to quantify them to permit the development of alternative components that could help to alleviate them.

I. Water Quality

Performance Measure: Mean grid cell total phosphorus concentration; Everglades Protection Area (EPA).
Goal: Mean grid cell phosphorus concentrations should not exceed 10 ppb in the EPA.
Problem: Alternative 2 created two additional grid cells in WCA-3B with mean grid cell phosphorus concentrations exceeding 45 ppb.
Recommendation: Current and future land uses must not preclude the development of necessary water treatment facilities for those components which involve new/additional water discharged to the EPA.

Performance Measure: Geometric mean total phosphorus concentration, 14 stations in the Loxahatchee National Wildlife Refuge (LNWR).
Goal: Geometric mean should not exceed long-term concentration limit in the Settlement Agreement (11 ppb).
Results: Alternatives 1 and 2 performed equally with respect to 14-station geometric mean in LNWR (<6 ppb).

Performance Measure: Stage Hydrograph at Taylor Creek-Nubbin Slough Reservoir.
Goal: Minimum stages should not fall below 2.0 ft to maximize water quality benefits to Lake Okeechobee. Upon re-wetting, the preferred minimum hydraulic retention time is 14 (?) days.
Note: It was difficult to ascertain how many storage events were less than the preferred duration.

Performance Measure: Lake Okeechobee phosphorus in-loads.

Goal: Unknown.
Results: It is likely that the actual performance of Alternative 2 is closer to that of Alternative 1, which was worse than both the 1995 and 2050 Base cases.

J. ATLSS/Threatened and Endangered/Keystone Species

Note: For the Cape Sable Seaside Sparrow, wading birds and white-tailed deer, ATLSS outputs for Alternative 2 continue to be limited to Breeding Potential Indices (BPIs). Individual-based simulations for these species are under development. Additional outputs on total fish abundance and fish prey base for wading birds are available for this round. An important difference in the Alternative 2 output vs. previous outputs is the use of high-resolution hydrotopography derived from the 2x2 SFWMM outputs rather than use of the raw 2x2 output. **This difference in input data makes quantitative comparisons of Alternative 2 outputs to Alternative 1 outputs and/or 1995 Base outputs impossible and makes qualitative comparisons questionable.**

Fish:
Results: The ATLSS fish model predicts that, due to overall wetter conditions in WCA-3B and south of Tamiami Trail, Alternative 2 hydrologic conditions will produce average fish abundances consistently higher than those expected for the 2050 Base, particularly in Shark River Slough and WCA-3B. This is also true when only prey-sized fish at appropriate wading bird foraging depths are counted. No recommendations are provided for desired improvements or structural / operational changes because no performance target has been set.

Wading Bird Breeding Potential Index:
Results: Consistent with the fish model output, Alternative 2 would result in a slight improvement in breeding potential for wading birds, over those expected for the 2050 Base, under most conditions due to dryer conditions in the deeper WCA areas and wetter conditions south of Tamiami Trail, particularly in Shark River Slough and its peripheral wetlands.
Recommendation: Reduce the number of hydroperiod reversals occurring during the December 15 to May 15 breeding period.

White-tailed Deer Breeding Potential Index:
Results: Alternative 2 will slightly reduce the generally poor breeding conditions for white-tailed deer in most of the modeled area as compared to the 2050 Base, particularly in years with average to above average rainfall. For those few areas with high deer breeding potential (Long Pine Key and surrounding short hydroperiod marsh), there is little difference between Alternative 2 and the 2050 Base.

Cape Sable Seaside Sparrow Breeding Potential Index:
Results: Differences in sparrow breeding potential for Alternative 2 and the 2050 Base are slight; however, for most years, the 2050 Base is more conducive to successful breeding in eastern and core areas vulnerable to flooding, while Alternative 2 provides better conditions in the northwestern parts of western habitat areas. The western subpopulations continue to be most sensitive to year-to-year changes. Alternative 2's increased flows to eastern Shark River Slough appear to provide slight improvements in breeding potential in the western habitat areas.

Recommendation: Any actions that would further decrease late wet season and dry season flows west of Shark River Slough may improve breeding potential for the particularly vulnerable western sparrow subpopulation. Once all measures to move water east have been exhausted, the ADT could try adding total removal of L-28 to see what happens.

AET Subteam Narratives

A. Total System Subregion

Performance Measure Used: % Hydroperiod Matches with NSM for the remaining Everglades, Holey Land and Rotenberger WMAs, the Pennsuco Wetlands, the WCA system, and Everglades National Park.

1. Description: Assuming the goal to be to match NSM in as many grids as possible, for the total remaining Everglades, Alternative 2 showed an increase of 8% in the number of grids matching NSM over the 2050 Base (1% better than Alternative 1). The big gains for this plan are the 20% improvement in the ENP (which represents a very large area) and the 22% improvement in the much smaller WCA-3B. However, except for WCA-3A and ENP, percentages of grids matching NSM are all below 80% and the improvements to WCA-2B made in the Starting Point and Alternative 1 were lost.

If one were to give rough "grades" to the percentages based on nothing but 10% intervals, the overall grade would be a 2.5 or a "C". There would be no "As", WCA-3A south and the Park would receive "Bs", Loxahatchee, WCA-2A and WCA-3A north would get "Cs", Rotenberger and Holey Land would get "Ds" and WCA-2B, WCA-3B and Pennsuco would receive "Fs" for hydroperiods.

2. Improvement needed: Hydroperiods need to be improved in all of the WCAs and ENP, particularly WCA-2B, WCA-3A north, WCA-3B, Rotenberger, Holey Land and the Pennsuco wetlands.

3. Structural and Operational Recommendations: No recommendations at this time.

Performance Measure Used: Mean NSM ponding matches for the remaining Everglades, Holey Land and Rotenberger WMAs, the Pennsuco Wetlands, the WCA system, and Everglades National Park.

1. Description: Assuming that the goal is to match NSM in as many grids as possible, Alternative 2 showed no improvement over the 2050 Base condition for the WCAs (73%). There was, however, a 7% improvement over the total remaining Everglades (86% match). This improvement takes place primarily in the Park where 100% of ENP grids matched NSM. 92% of the much smaller Rotenburger matched (although, keep in mind that the hydroperiods in Rotenberger was matched only 69% of the time). Depths are also good for WCA-3A north (86%) although they are 85% in the 2050 Base. Compared to the 2050 Base, Alternative 2 was

2% worse for Loxahatchee (from 58% to 56% - not too good to begin with). The 25% improvement in the Pennsuco made in Alternative 1 continues, bringing it up from 50% to 75%, a significant improvement (although hydroperiod matched only 25% of the time). Compared to Alternative 1, Alternative 2 is an improvement in all the WCAs except Loxahatchee and WCA-2A.

2. Improvement needed: Ponding depth-wise, the Park and Rotenberger are probably done. The task will be to maintain ponding depths while shifting focus to the WCAs. The lowest percentage matches are found in WCA-2B (only 18%) and the second lowest in Loxahatchee (56%). These two areas really need to be looked at as neither shows any improvement over the 2050 Base case.

3. Structural and Operational Recommendations: None.

Performance Measure Used: Hydroperiod Improvement Relative to 2050 Base for the remaining Everglades, Holey Land and Rotenberger WMAs, the Pennsuco Wetlands, the WCA system, and Everglades National Park.

1. Description: Only 25.8% of the areas match NSM in the Everglades as a whole, and only 10.3% of the WCAs match. Over 900K acres showed no change at all compared to the 2050 Base, 343K acres improved, 307K of which were within ENP, almost 40K over Alternative 1. Alternative 2 also managed to offset the extreme wet and dry conditions found in large areas under Alternative 1. For example, for the remaining Everglades, Alternative 1 showed over 100K acres to be too dry and another 100K too wet, compared to NSM. In Alternative 2, those acreages were reduced by about half. The exceptions are Rotenberger and Holey Land. Around 2.5K acres in Rotenberger are now too dry with no improvement. Holey Land is a mixed bag; it now has 10K (of its 35.8K acres – nearly a third) too dry and 5K too wet in exchange for 7.6K acres of improvement.

2. Improvement needed: Some of the improvements made to the WCAs in Alternative 1 were lost in Alternative 2, although the Park continued to benefit. Loxahatchee, WCA-2A and WCA-2B are actually worse off as many acres appear to be too dry. While the Park could still use help (only 63% match NSM), the upper WCAs need it too. Continue to correct the too dry and too wet extremes.

3. Structural and Operational Recommendations: None.

Performance Measure Used: Mean Hydroperiod Distribution for the 31-year period of record for the remaining Everglades.

1. Description: Compared to the goal of matching the distribution of the NSM, there are still too few acres that are inundated 330-365 days a year although conditions have improved over the 2050 Base condition in that category. Alternative 1 and the Starting Point did a better job in the total inundation category. Alternative 2 does show an increase in the adjacent category (330-365 day) over Alternative 1 and is now very close to NSM predictions again (the 2050 Base was close and slightly over). There are too many areas flooded 240-300 days. Depending on where

these areas are (which cannot be told from this graph), they may be candidates for increasing hydroperiod to 330-365 days.

2. Improvement needed: Increase the number of acres with the longest hydroperiods.

3. Structural and Operational recommendations: None at this time.

Technical Issues: None at this time.

Non-Technical (Process) Issues: None at this time.

Summary of Comments Received:

1. Tom Corcoran of the National Audubon Society noted that the NSM4.5 Hydroperiod Distribution Map, dry condition 1989, shows comparatively small areas of peripheral/shorter hydroperiod wetlands on the eastern border of the inundated areas from Palm Beach County to Miami-Dade County. Alternative 2 under the same conditions indicates very little of these wetlands. This might make it doubly important to create the WPAs and manage them to simulate short hydroperiod wetlands. While these areas are small, they may have a very high significance to wildlife.

Also, for Alternative 2's 60,000 to 75,000-acre reservoir for storage in the EAA, he suggests the ADT use NSM4.5 timing and hydroperiod duration targets utilizing the reservoir storage to strive for more natural conditions in WCAs, and ultimately ENP/Shark River Valley.

Editor's note: Alternative 2 simulated 40,000 acres of storage in the EAA.

2. Steve Lamb, affiliated with the agricultural coalition, commented on water supply, noting that C-43 basin regional irrigation supply and demands not met indicate that 26 % of the demand will be met by ASR. It is not clear to him when this is used but nothing indicates that regional ASR at this level of 250 mgd will create a bubble that can achieve this level of recovery for extended periods. He suggested the ADT needs to analyze ASR storage itself, not just the water budget from the surface. In addition, it is not clear to him what impact this amount of recharge will have on the aquifers, the quality changes on existing uses, etc.

3. Tom MacVicar, affiliated with the agricultural coalition, had four comments:

Focus: Water Supply.
Performance Measure: Stage Hydrographs at Site 1 Reservoir.
Comments: This reservoir is too small to make a meaningful stand-alone contribution to reducing flow to tide or satisfying dry-season water demands in the basin. The reservoir is empty during the critical months of every year when supplemental water supply is needed. Site 1 should be simulated as an STA that treats basin runoff and pumps it into WCA-1. It is not practical for water supply, or desirable environmentally, to discharge from Site 1 into WCA-2A. As an STA, it could add to both urban and environmental water supply in WCA-1.

Focus: Water Supply.
Performance Measure: Stage Hydrographs at EAA Reservoir.
Comments: The EAA Reservoir introduces a large new water loss into the Everglades system because of the increase in evapotranspiration. During periods when the reservoir can receive lake regulatory releases, this is not a concern. However, there are prolonged periods when lake water is not available. For the period between 1971 and 1978, the reservoir results in a cumulative net loss in excess of 350,000 acre-feet of water from the Everglades system. From 1985 to 1992, the loss exceeds 400,000 acre-feet. There are serious water shortages in the LOSA during both these periods.

Focus: Water Supply.
Comments: The hydrographs in northern WCA-3A, which is the area that receives water from the reservoir, show very little change from the 2050 Base with no reservoir to Alternative 2. Since this is the only proposed reservoir which receives water that would otherwise go to the Everglades it is important that an analysis be performed to pinpoint exactly what the benefits of this idea are and some method be developed to document the impacts. This should be discussed in both the AET and ADT team meetings.

Focus: Flood Control.
Performance Measure: S-175 Headwater.
Comments: This hydrograph appears to show the opposite of what could be expected. The 1995 Base should not produce stages as high as those shown and the 2050 Base and the alternatives should produce higher stages and more variability than what is shown. It would be more meaningful to show S-177 stages rather than S-175. After the C-111 project, S-175 will be much less significant. Saltwater intrusion criteria for S-177 would be useful since the Keys wellfield is nearby. Intrusion at S-175 is not meaningful.

Focus: Flood Control.
Performance Measure: S-174 Headwater.
Comments: The 2050 Base and Alternatives 1 and 2 all cause an increase in flooding to farmland in south Dade. This appears to be caused by the way the C-111 and Modified Water Delivery Projects are being simulated. The 2050 Base assumptions about those projects should be changed to eliminate the flooding that the current simulated operating plans would cause. The increase in the level at the S-174 Headwater, combined with continued wet season flow through S-331 will cause flood damage to agricultural land and crops.

B. Kissimmee / Lake Okeechobee Subregion

Performance-Based Comments:

There were no performance measures evaluated for the Kissimmee region.

Surface water inputs to the lake differed by only 0.1% among the 2050 Base, Starting Point, Alternative 1 and Alternative 2 conditions. Surface water outflows from the lake, and losses to evapotranspiration also were nearly identical among these different scenarios. One notable change with Alternative 2 was a reduction in direct water inputs from Taylor Creek, and

a new source of input water from a Taylor Creek reservoir. This change may have its greatest effect on the nutrient content of inflowing water, a topic that will be addressed by the Water Quality subteam.

Stage duration curves indicate that alternatives tested to date all achieved higher water level regimes for the lake than the 2050 Base condition, but lake levels still were lower than under the 1995 Base. The improvement over 2050 Base conditions is most evident at the lower end of the duration curve. Stage duration curves for the Starting Point, Alternative 1 and Alternative 2 were virtually identical.

Box-and-whisker plots showing the "similarity in lake stages" indicate that median, maximum and minimum water levels were nearly identical under the Starting Point, Alternative 1 and Alternative 2, and were generally similar to those under the 1995 and 2050 Base conditions. All cases gave considerably more variation in lake levels (both at the high and low ends) than is considered optimal for maintaining a healthy ecosystem and its associated ecological and societal values.

The daily stage hydrographs indicate the following return frequencies (number of events in 30 years) for extreme high (> 17 ft NGVD) and low (< 11 ft NGVD) lake stages:

Category	95 Base	50 Base	STRTPT	Alt1	Alt2
> 17 ft	5	5	5	5	4
< 11 ft	8	12	10	10	10

There is little difference among the different scenarios in regard to the frequency of the extreme high events, except for a 20% reduction under Alternative 2. This represents a step in the right direction, as the ultimate goal is to avoid such harmful events. When lake levels reach 17 ft, wind-driven waves can seriously damage native plant communities and fisheries habitat, even in very short time periods, and there also may be considerable nutrient transport into the oligotrophic marsh from the eutrophic pelagic zone.

There was an increase (by 25%) in the frequency of extreme low lake levels under 2050 Base conditions, and this "problem" is only partially rectified by the various alternatives. This is a concern because when the lake falls below 11 ft, nearly all of the littoral marsh is exposed to drying, it no longer can serve as a habitat for fish and other aquatic animals, and it is at increased risk for expansion of exotic plants.

Box-and-whisker plots showing the similarity in duration of stage events >15 ft NGVD indicate that the Starting Point, Alternative 1 and Alternative 2 scenarios produced median durations for such events that were considerably lower than under 2050 Base conditions. These are positive results, because prolonged periods of moderately high lake levels harm the ecosystem due to losses of benthic plant communities, and greater lake-wide circulation of

turbid, phosphorus-rich water. Increases in lake-wide phosphorus concentrations could impact downstream ecosystems that receive water from the lake. The upper quartiles of the distributions still are higher than is desired to promote a healthy ecosystem, but to a large extent this reflects one prolonged event (lasting 900 days). This occurred due to a 1 in 300-year rain event in south Florida, and may not be a problem that can be fixed by the Restudy.

Box-and-whisker plots showing the similarity in duration of stage events <12 ft NGVD indicate that the Starting Point and Alternative 1 produced median durations for such events that were considerably lower than under 2050 Base conditions. This also is a positive result, because prolonged periods of moderately low lake levels harm the ecosystem due to losses of wildlife habitat and increased rates of exotic plant expansion. Under Alternative 2, the duration of such events was somewhat increased in comparison with Alternative 1. Thus, in regard to this performance indicator, the lake moved away from its restoration target.

Box-and-whisker plots showing the similarity in duration of stage events <11 ft NGVD indicate that Alternative 1 and Alternative 2 gave median durations for such events that were considerably lower than under 2050 Base and Starting Point conditions. This is another positive result. A single <11 ft event lasting over 400 days did continue to occur under Alternative 2. It appears to be due to greater water demands under the 2050 Base condition, since the duration under the 1995 Base was closer to 200 days. Closer examination of the daily stage hydrograph indicates that the event occurred in 1981-82. Under 1995 Base conditions, the lake rebounded to above 11 ft between two shorter-duration low water events. Under the 2050 Base and alternative conditions, the lake remained low. Conditions that prolong extreme lows are undesirable and should be avoided.

All scenarios gave similar scores for spring lake level recession. Additional statistical evaluations are needed to quantify how wading bird foraging and nesting correspond with the spring recession, or water level variations in general. Until this is done, this particular measure should be considered with caution.

Comments Received By Email from Outside Reviewers:

1. Lorraine Heisler (Florida Game and Freshwater Fish Commission)

   Alternative 2 represents a slight improvement in regard to extremes of lake stage, in comparison with the 2050 Base, but there is no improvement relative to the 1995 Base. Need to reduce duration of both high and low stage events. Should combine structural changes with operational changes, i.e., consider effects of a modified regulation schedule (Run 22 AZE).

2. Tom Corcoran (National Audubon Society)

   Alternatives 1 and 2 have nearly identical stage duration curves in respect to lake stages >15 ft, where the entire littoral zone is flooded.

3. Tom MacVicar (representing the agricultural coalition)

The water budget for the North Storage reservoir shows a large seepage loss term, more than 50% of the lake regulatory releases pumped into the reservoir in some years. Need to account for this water. There also is a large amount of spillover from the reservoir during same months when water is being added from the lake. Should stop pumping water into the reservoir at a depth of at least one foot below the spillover depth, to allow room for rainfall.

Performance Measures and Indicators Used:

Measures: box-whisker plots showing similarity in lake stages
box-whisker plots showing duration of >15 ft lake stage events
box-whisker plots showing duration of <12 ft lake stage events
box-whisker plots showing duration of <11 ft lake stage events
daily hydrographs with spring recession windows

Indicators: lake inflow, outflow, and ET volumes
30 year daily hydrographs
stage-duration curves

Highlights Regarding Alternative 2:

1. Frequency of extreme high (>17 ft) lake stage events

    a. Under all scenarios evaluated to date, the lake displayed a greater range of maximal water depths than is optimal for a healthy ecosystem. Lake levels exceeded 17 ft on four occasions.

    b. The frequency of occurrence for >17 ft events should be minimized; the restoration goal is to have no such events.

2. Frequency of extreme low (<11 ft) lake stage events

    a. Under all scenarios evaluated to date, the lake displayed a greater range of minimum water depths than is optimal for a healthy ecosystem. Lake levels fell below 11 ft on ten occasions.

    b. The frequency of occurrence for <11 ft events should be minimized; the restoration goal is to have no such events.

3. Duration of moderately high (>15 ft) lake stage events

    a. Under the alternatives evaluated to date, there were three events wherein lake stage exceeded 15 ft for over 1 year. Events of this nature damage submerged plant communities and fisheries, and impair water quality.

    b. The restoration goal is to have no prolonged (>six months) events of this type.

4. Duration of moderately low (<12 ft) lake stage events

   a. The median duration of <12 ft lake stage events, as well as the maximal duration of such events, exceed restoration goals. Conditions were actually worsened under Alternative 2, as compared to the previous alternatives.

   b. The restoration goal is to have no prolonged (>six months) events, while under Alternative 2 there were six such events.

C. Lake Okeechobee Service Area Subregion

Performance Based Comments:

Total EAA/LOSA irrigation demands and demands not met level of certainty do not meet Restudy planning goals. The state's water supply goal of meeting demands in a 1 in 10 year drought is not met by Alternative 2. Examination of the Lake Okeechobee daily stage hydrograph and the monthly supply-side management reports show that the Lake Okeechobee Service Area is modeled as being under supply-side management for 16 events. In several situations lake levels were very low and minimal water supply deliveries were made for 5-6 months in a row. There are six growing seasons in which the water supply cutback is over 200,000 acre feet, and four additional years of lesser cutbacks. The frequency of water shortages has improved over the 2050 Base (19 events), but is worse than the Starting Point and Alternative 1.

Alternative 2 showed five lake triggered water shortage events in each Lower East Coast Service Area. The target is three including both lake triggered and locally triggered events.

Alternative 2's cumulative total demands not met are worse than Alternative 1, the Starting Point, and the 1995 Base, but are better than the 2050 Base for all agricultural basins but the Caloosahatchee. The Alternative 2 situation in the Caloosahatchee Agricultural Basin has deteriorated (11.11%) as compared to the Starting Point (10.28%), and is an improvement over the 1995 Base, 2050 Base and Alternative 1.

The average inflows and outflows to Lake Okeechobee graphic shows Alternative 2 backpumping to the lake to be approximately 30% of the amount in the 1995 Base and approximately 50% the amount in the 2050 Base. As an indirect measure of the maintenance of flood protection in the EAA, this indicates that flood protection has not deteriorated.

Performance Measures and Indicators Used:

1. Lake Okeechobee Daily Stage Hydrograph
2. Mean Annual EAA/LOSA Irrigation Demands and Demands not Met
3. Report – Monthly and Annual Supply-Side Management Results
4. Report – Cumulative Total Demand, Cutback Volume, and Cutback over Period of Simulation

5. Water Shortages by Phase and Trigger output
6. EAA and LOSA Demands – Dry Years
7. Total Irrigation Supply and Shortages for Seminole Tribe, Big Cypress Reservation
8. Lake Okeechobee Service Area Subregion Reports on Annual Demands & Demands not Met
9. C-43 & C-44 Basin Regional Irrigation Supply and Demand not Met
10. Other LOSA Supplemental Irrigation Supply and Demand not Met
11. Number of Undesirable Lake Okeechobee Stage Events
12. Peak Stage Differences (.25 ft. higher)
13. Average Inflows and Outflows to Lake Okeechobee

Public Comments Received (paraphrased):

1. Gail Murray for the Seminole Tribe: Thank you for creating the requested performance measure. The percent of demands not met increased for both Reservations. It is not apparent what caused the reductions. A continued decrease in water supply is not acceptable.

D. Lower East Coast Subregion

Summary:

In general, Alternative 2 improves the ability of the regional system to meet water supply demands for the Lower East Coast when compared to Alternative 1. However, it does not meet the 1 in 10 year water demand. Shortages triggered by local ground water levels and Lake Okeechobee levels are too frequent. In addition, saltwater intrusion continues to be a threat in southern Service Area 2 and all of Service Area 3. The majority of the local ground water trigger cutbacks in the service areas are due to just a few wellfields, that is, low ground water levels are not affecting the entire service areas. Addressing these few wellfields will enable the service areas to avoid cutbacks. The shortages due to Lake Okeechobee levels still need to be addressed. The number of cutbacks has not declined over the 1995 Base. Flood protection in the south Dade area continues to be a problem.

Water Supply:

Comparison of performance measure to base cases and previous alternatives:

1. Number of Times of Simulated Water Supply Cutbacks triggered by Lake Okeechobee for the 1965-1995 Simulation Period for the LECSA

While Alternative 2 is an improvement over the 2050 Base, Starting Point, and Alternative 1, it shows little to no improvement over the 1995 Base nor is the 1 in 10 level of certainty met for the entire LECSA. The number shortages triggered by Lake Okeechobee stages is unacceptable for all of the LECSA (13-16 times for each SA).

Improvement needed to meet target:

Reduce the number of local ground water and Lake Okeechobee triggered cutbacks to 1 in 10 level of certainty (no more than three events for period of record).

Recommendations for structural/operation changes:

1. The ADT needs to make more water available from Lake Okeechobee to avoid water shortages. Perhaps combine ASR with a modified regulation schedule.
2. Currently the EAA is the biggest user of water from Lake Okeechobee, while average annual deliveries to LEC are minimal in comparison (and generally declining across the alternatives). The ADT needs to look at alternative sources of water for the EAA. Perhaps ASR could be more appropriate for the EAA, while the water supplied by reservoirs could be used for LEC deliveries.
3. Another option would be to remove, or alter the Lake Okeechobee trigger for LEC cutbacks since the dependence of the LECSA on average annual deliveries from the regional system generally declines across the alternatives compared to the 1995 Base.

Comparison of performance measure to base cases and previous alternatives:

NPBC: The number of locally triggered events has been significantly reduced for compared to the 2050 and 1995 base cases. . The L-8 component appears to be working. However, Riveria still experiences a high number of cutbacks (eight times).

Improvement needed to meet target:

Reduce the number of local ground water and Lake Okeechobee triggered cutbacks to 1 in 10 level of certainty (no more than 3 events for period of record).

Recommendations for structural/operation changes:

1. Adding ASR to L-8 option would improve flows and recharge.

Comparison of performance measure to base cases and previous alternatives:

Service Area 1: The number and duration of locally triggered cutbacks is acceptable in Service Area 1 (only one time).

Improvement needed to meet target:

Reduce the number of local ground water and Lake Okeechobee triggered cutbacks to 1 in 10 level of certainty (no more than three events for period of record).

Comparison of performance measure to base cases and previous alternatives:

Service Area 2: The number and duration of locally triggered cutbacks is unacceptable in SA2 due to Hollywood (45 times, approximately 12% of the time) and Ft Lauderdale Airport (31 times). In addition, there are 16 Lake Okeechobee triggered events for SA2.

Improvement needed to meet target:

Reduce the number of local ground water and Lake Okeechobee triggered cutbacks to 1 in 10 level of certainty (no more than three events for period of record).

Recommendations for structural/operation changes:

1. For Hollywood, shift 31MGD of demand to South Broward County Regional Wellfield, the Floridan remains at 4 MGD, demand from 3A shifts to South Broward County Regional Wellfield, shift all of Dania and Hallandale's demand to South Broward County Regional Wellfield (variation of component L2).

2. Provide surface water recharge to Dixie-Peele Wellfield from the canal east of the turnpike which leads to the C-12 (control structure is just north of Broward Blvd). The pumps and canal capacities will need to be improved and expanded.
3. The ADT needs to improve management of WCA-3B. The water is piling up behind the seepage control structure and not providing any benefits. The ADT needs to either add seepage to send ground water south and east to recharge wellfields and canals or move it south to ENP.
4. Although Pompano is not causing any locally triggered cutbacks, it does experience saltwater intrusion problems in its wellfields. The easternmost pumpages should be moved to the North County Regional Wellfield in Alternative 3.

Comparison of performance measure to base cases and previous alternatives:

Service Area 3: The number and duration of locally triggered cutbacks is unacceptable in Service Area 3 due to Homestead (17 times), Florida City (two times) and Taylor (four times). In addition, there are 16 Lake Okeechobee triggered events for Service Area 3. This is a higher frequency than the 1995 Base and Alternative 1.

Improvement needed to meet target:

Reduce the number of local ground water and Lake O triggered cutbacks to 1 in 10 level of certainty (no more than three events for the period of record).

Recommendations for structural/operation changes:

1. Fill in C-111 from S-18C south and add a spreader canal east from S-18C. This may reduce losses from canal system and increase deliveries to Model Lands. Maintaining flood protection may need to be reviewed carefully.
2. Modify levee seepage control along L-31N and remove the curtain wall around central lake belt storage or move the reservoir north. (See recommendations for Central Lake Belt Reservoir.)

Canal Levels:

Comparison of performance measure to base cases and previous alternatives:

NPBC and Service Area 1: All canal levels meet or exceed the salt-water intrusion criteria.

Comparison of performance measure to base cases and previous alternatives:

1. % of Time Canal Stage < Salt-Water Intrusion Criteria and Occurrences >1 Week - Canal C-14 at S-37B and North New River @S-54

   Service Area 2: The performance measure meets or exceeds criteria in Alternative 2.

Comparison of performance measure to base cases and previous alternatives:

1. % of Time Canal Stage < Salt-Water Intrusion Criteria and Occurrences >1 Week - Canal C-9 at S-29

Alternative 2 shows an increase in the number of saltwater intrusion trigger events relative to Alternative 1. The canal is below minimum level 17% of the time (~4.5+ years). This indicates that ground water levels are somewhat lower than in Alternative 1, which also means that the ground water deliveries to Biscayne Bay would be less than in Alternative 1. This alternative is, therefore, worse than Alternative 1 with respect to conditions in Biscayne Bay. The lower canal stages are also impacting the Hollywood local ground water trigger, which triggered shortages 45 times in the period of record. The link between canal stages and local ground water triggers is strongest when the canal drops below 2 ft.

The stage duration curves show that approximately half of the time, ground water levels for all alternatives are at a height which is at or just above the saltwater intrusion trigger level. Both the 1995 Base and 2050 Base have ground water levels that more than half of the time are at least a few inches higher than the saltwater intrusion triggers. The difference of a few inches in hydraulic head may be sufficient to provide more freshwater deliveries to the bay via ground water and the aquifer near the Hollywood wellfields. Alternatives that support higher ground water levels to prevent saltwater intrusion and trigger shortages are absolutely necessary.

Improvement needed to meet target:

Meet or exceed the minimum level to prevent saltwater intrusion in C-9 all the time. The ADT needs to hold more water longer in the canals and restore wet season flows. The lack of ground water seepage cannot be overcome by surface water canal deliveries.

Recommendations for structural/operation changes:

1. Reduce the block on ground water seepage at the bottom of WCA-2B.
2. Send more flows east instead of south to the Water Preserve Area (Lakebelt).
3. Increase structures and pumps on L31N between Kendall Drive and Tamiami Trail to control water levels.
4. Develop ASR along L31-N from C-1 south to ENP entrance (S-177) to meet local water supply needs and to provide recharge to canals in the dry season.

Comparison of performance measure to base cases and previous alternatives:

1. % of Time Canal Stage < Salt-Water Intrusion Criteria and Occurrences >1 Week - Canal C-6 at S-26
2. % of Time Canal Stage < Salt-Water Intrusion Criteria and Occurrences >1 Week - Canal C-4 at -25B
3. % of Time Canal Stage < Salt-Water Intrusion Criteria and Occurrences >1 Week - Canal C-2 at S-22

Service Area 3: Alternative 2 shows an increase in the number of saltwater intrusion trigger events relative to Alternative 1 in C-6. The canal is below minimum level 9% of the time. Alternative 2 shows an increase in the number of saltwater intrusion trigger events relative to Alternative 1 in C-4. C-4 is below minimum level 13% of the time. Alternative 2 shows an increase in the number of saltwater intrusion trigger events relative to Alternative 1 in C-2. The canal is below minimum level 11% of the time. This indicates that ground water levels are somewhat lower than in Alternative 1, which also means that the ground water deliveries to Biscayne Bay would be less than in Alternative 1. This alternative is, therefore, worse than

Alternative 1 with respect to conditions in Biscayne Bay. The seepage mechanism on the L-31N appears to be affecting the C-4 and C-2 and may also affect the West Wellfield. Deliveries and recharge to the canals and wellfield should be maintained.

The stage duration curves show that approximately half of the time, ground water levels for all alternatives are at a height which is at or just above the saltwater intrusion trigger level. Both the 1995 Base and 2050 Base have ground water levels that more than half of the time are at least a few inches higher than the saltwater intrusion triggers. The difference of a few inches in hydraulic head may be sufficient to provide more freshwater deliveries to the bay via ground water.

Improvement needed to meet target:

Meet or exceed the minimum level to prevent saltwater intrusion on primary canals all the time. The ADT needs to hold more water longer in the canals and restore wet season flows. The lack of groundwater seepage cannot be overcome by surface water canal deliveries.

Recommendations for structural/operation changes:

1. Reduce the 100% block on ground water seepage as described in component V2.
2. Increase the use of ASR on Snake Creek and the Miami River.
3. Develop ASR along L-31N from C-1 south to ENP entrance (S-177) to meet local water supply needs and to provide recharge to canals in the dry season.
4. Increase structures and pumps on L-31N between Kendall Drive and Tamiami Trail to control water levels and divert to primary canals as necessary to maintain levels. One structure on the L-31N is being considered as a Critical Project. Additional structures may be useful.

Reservoirs:

Comparison of performance measure to base cases and previous alternatives:

Bird Drive Reservoir: As mentioned in the comments on Alternative 1, the surface elevation portrayed in this performance measure is questionable since it shows 1995 Base levels exceeding surface only approximately 1% of the time. Field observations indicate that there is surface water in this portion of the Bird Drive Basin approximately 2 - 3 months out of the year, which equates to approximately 20% of the time. Using inadequate surface elevations result in under reporting the water supply provided by this basin under current conditions.

Improvement needed to meet target:

The ADT needs to correct how the component operates and how the model is calibrated for this area.

Recommendations for structural/operation changes:

1. The ADT needs to address water quality concerns. This facility is located within the West Wellfield Interim Protection Area and, therefore, only water of the appropriate quality should be back pumped into this facility.

Comparison of performance measure to base cases and previous alternatives:

Central Lakebelt In-ground Storage Reservoir: The area proposed for the storage reservoir is located within the wellfield protection area of the Northwest Wellfield which supplies water to businesses and residents north of Tamiami Trail. Miami-Dade County has implemented an extensive wellfield protection program to minimize risks to that water supply. While in theory a subterranean seepage barrier should not leak, reality could prove otherwise and it would be difficult to support assuming such a risk to the current high quality of water withdrawn from that wellfield. Therefore, water pumped into the reservoir would have to meet appropriate water quality standards and concomitantly may require treatment. Additionally, the Lakebelt In-ground Storage Reservoir will affect the cone of influence of the Northwest Wellfield by shifting it further east and south into industrially developed areas north of Tamiami Trail.

Improvement needed to meet target:

The ADT needs to create a component that is feasible, will not compromise ground water quality, will not impact cone of influence for the Northwest Wellfield, and will not impact the Pennsuco wetlands.

Recommendations for structural/operation changes:

1. As an alternative to the Central Lakebelt In-ground Storage Reservoir, the LEC Subteam recommends that the Restudy consider, in Alternative 3, locating this storage reservoir and an associated stormwater treatment area in the C-9 Basin south of the C-9 canal. A significant portion of this area was approved for rock mining by the Lakebelt Issue Team and is being actively mined. Rock mining companies own 4,800 contiguous acres in the area. Additionally, there is one square mile of publicly owned land bordering the south side of the C-9 canal, which could potentially be used for a stormwater treatment area.

Discharges to Tide:

Although there is no performance measure for discharges to tide from the urban area, this performance indicator is useful to review. For Alternative 2, there is a trend from north to south of decreasing discharges to tide while failure to meet salt-water increases. Discharge to tide in the North Palm Beach Service Area remains constant when compared to the 1995 Base and saltwater intrusion criteria for major canals is met. For Service Area 1, there is a 25% average annual decrease (256K acre-feet/yr) in discharges to tide when compared to the 1995 Base and the saltwater intrusion criteria for major canals is met. For Service Area 2, discharges to tide decrease approximately by one-third (157K acre-feet/yr) on average compared to the 1995 Base, while all but one canal, the C-9 is able to meet its saltwater intrusion criteria. In the case of Service Area 3, there is a 40% decrease in discharges to tide on average (400K acre-feet/yr) when compared to the 1995 Base, while all of the primary canals fail to meet their saltwater intrusion criteria.

Water Deliveries:

Comparison of performance measure to base cases and previous alternatives:

Water supply deliveries to Service Area 2 increase modestly for Alternative 2 during drought years (76K ac/ft) when compared to average annual deliveries (42K ac/ft) which may be impacting Hollywood and Ft Lauderdale Airport triggers. Other service areas have much greater deliveries, both annual average and during drought years. Service Area 1 has 119K ac/ft on average, 213K ac/ft during drought years - an increase of 100K ac/ft; while Service Area 3 has 80K ac/ft delivered on average and 248K ac/ft during drought years - a dramatic increase.

Improvement needed to meet target:

Reduce the number of local ground water and Lake Okeechobee triggered cutbacks to 1 in 10 level of certainty (no more than three events for period of record).

Recommendations for structural/operation changes:

The ADT needs to increase deliveries to Service Area 2 during drought years (or increase ground water seepage).

Comparison of performance measure to base cases and previous alternatives:

In Alternative 2, average annual deliveries from Lake Okeechobee and WCAs to Service Area 3 increase when compared to Alternative 1, yet the canal stages are still below the saltwater intrusion criteria for the canals and flows to Biscayne Bay are still too low (even lower than the 1995 Base). The deliveries in Alternative 2 decline when compared to the 1995 Base,

Improvement needed to meet target:

Reduce the number of local ground water and Lake Okeechobee triggered cutbacks to 1 in 10 level of certainty (no more than three events for period of record).

Flood Protection:

Comparison of performance measure to base cases and previous alternatives:

Stage Hydrographs for R10C25, R17C27, R13C25, R15C26 indicate an increase in flooding potential when comparing Alternative 2 to the 1995 Base, 2050 Base, and Starting Point. The 2 foot root zone is exceeded 21 to 62 times for these cells.

Improvement needed to meet target:

Capture enough seepage to avoid exceeding the 2 foot root zone during the growing season while not diminishing flows to Biscayne Bay.

Recommendations for structural/operation changes:

1. Capture wet season seepage from L-31N moving east into the agricultural areas.
2. Develop ASR along L-31N from C-1 south to ENP entrance (S-177) to meet local water supply needs and to provide recharge to canal in the dry season.
3. The ADT needs to modify how C-111 and Modified Water Deliveries Projects are being simulated. By modifying the 2050 Base, the flooding caused by the current simulated operating plans may be eliminated.

Comparison of performance measure to base cases and previous alternatives:

Stage Hydrographs for R19C27 indicate a decrease in flooding potential when comparing Alternative 2 to the 1995 Base. However, the 2 foot root zone is exceeded 57 % of the time.

Improvement needed to meet target:

Avoid exceeding the 2 foot root zone during the growing season.

Performance Measures and Indicators Used:

Same as Alternative 1 with the addition of simulated annual demands not met due to water restrictions per year for each service area, stage duration and stage hydrographs for the reservoirs, and simulated mean annual surface flows discharges into Biscayne Bay for the simulation period.

Further Recommendations:

An alternative that implements the least drastic modifications to the system, sort of a low-tech version to meet performance measures should be developed. The results would be useful to evaluate the full range of alternatives and their associated tradeoffs.

E. Northern / Central Everglades (WCAs, Holey Land, Rotenberger)

Holey Land and Rotenberger WMAs

Performance Based Comments:

In Holey Land WMA, the duration of inundation and average hydroperiod in Alternative 2 are similar to NSM and are improved (= reduced) over the 2050 Base. However, Alternative 2 depths are too high and last for too long. During the wettest years depths exceeded 2.0 ft as well as NSM peak stages, and did so for extended periods. On approximately ten occasions depths remained above 1.5 ft for nearly a year. On average, Alternative 2 exceeded NSM by about 0.3 ft year round. This is a slight improvement (approximately 0.1 ft reduction in depth) over the 2050 Base but approximately 0.5 ft deeper than the 1995 Base.

In Rotenberger WMA, the mean hydroperiod is three weeks longer than NSM (84% in Alternative 2 vs. 79% in NSM), with fewer dry-outs and longer periods of flooding. This is similar to the 2050 Base (86% hydroperiod) and much wetter than the 1995 Base (58% hydroperiod). Depths in Rotenberger exceed 1.5 ft approximately 18% of time in Alternative 2 but only about 7% of time in NSM. Depths greater than 2.0 ft occur about twice as often as in NSM. As with hydroperiod, Alternative 2 depths are similar to the 2050 Base but deeper than the 1995 Base. Seasonal timing of depth variation is similar in Alternative 2 to NSM, but the water is about 0.3 ft deeper year round; this is slightly shallower than the 2050 Base but approximately 1.0 ft deeper than the 1995 Base.

Prolonged ponding is of great concern for both Holey Land and Rotenberger WMAs because deeper, ponded water is associated with increased risk of cattail proliferation. This has been a severe problem in Holey Land during recent years and is expected also to be a problem in Rotenberger if ponding depths there increase substantially. In addition to risk of cattail proliferation, waters in excess of approximately 1.5 ft deep eliminate all terrestrial refugia in both areas.

Performance Measures Used:

The Performance Measures used were those for Indicator Regions 28 and 29. (Note: because the programming for these measures is not yet complete, depth differences had to be visually estimated from graphs; hence, the numerical values reported above could change in future evaluation cycles when more precise results are available.)

1. Inundation Duration. Mean hydroperiod, number of inundation events, and mean duration of inundation were compared for match with NSM values.
2. Extreme High Water (protection of upland refugia and tree islands). The frequency and duration of events in which depths exceeded 1.5 ft were estimated, with a planning target of zero exceedences of the criterion.
3. Extreme High Water (NSM flood levels). The frequency and duration of high-water periods in which depths exceeded NSM values were estimated, with a planning target of zero exceedences of NSM values.
4. Extreme Low Water (protection of peat soils). The frequency and duration of events in which depths fell below -1.0 ft were estimated, with a planning target of zero exceedences of the criterion.
5. Extreme Low Water (NSM low water levels). The frequency and duration of low-water periods in which depths fell below NSM minima were estimated, with a planning target of zero exceedences of NSM values.
6. Timing of high and low stages. The weeks in which annual average high water and annual average low water occurred were compared to NSM, with a planning target of matching NSM timing.
7. Interannual variation in weekly mean depth. The weeks having the highest and lowest values of the interannual standard deviation in mean weekly depth were estimated, with a planning target of matching NSM timing and approximate matching of NSM magnitude.

Performance Indicators Used:

1. Normalized Weekly Stage Hydrograph for Indicator Regions 28 and 29
2. Temporal Variation in Mean Weekly Stage for Indicator Regions 28 and 29
3. Inundation Pattern (1965-1995) for Indicator Regions 28 and 29
4. Stage Duration Curves for Indicator Regions 28 and 29

Recommendations:

1. In Holey Land, depths should be decreased by approximately 0.3 ft year round relative to Alternative 2. In Rotenberger, the hydroperiod should be reduced by about 5%, and year-

round depths by about 0.25 ft, relative to Alternative 2. In both WMAs, these changes should not cause an increase in the frequency of drying below -1.0 ft.

Loxahatchee National Wildlife Refuge (WCA-1)
Performance Based Comments:

In southern LNWR, depths in Alternative 2 exceeded 2.5 ft approximately eight times, for a total of 20% of the simulation period. This is a reduction of 10% of time over the 1995 Base, but it does not differ from the 2050 Base. The frequency and duration of deep water in southern LNWR in Alternative 2 is very different from NSM, which never exceeds 2.5 ft depth. No other performance measures were evaluated during this cycle.

Performance Measures and Indicators Used:

1. Extreme High Water (protection of tree islands). The frequency and duration of events in which depths exceeded 2.5 ft were estimated, with a planning target of zero exceedences of the criterion. Values were estimated using four performance indicators: Normalized Weekly Stage Hydrographs and Stage Duration Curves for each of Indicator Regions 26 and 27.

Recommendations:

1. The AET recommended that rainfall-based operations be evaluated for LNWR in Alternative 3, along with whatever structural changes are needed to avoid over-drainage of the northern part of the refuge. Additional components to improve connectivity with the rest of the WCA system may be included as part of Alternative 4. It was emphasized that any structural components, such as weirs in the perimeter canals, need to be designed so as to avoid impacts to water quality in the marsh interior, where clean, acidic water conditions currently prevail.

Subteam Issues:

Evaluation of model performance for LNWR is complicated by a lack of clear planning targets for this area. During December, ADT members spoke with LNWR staff, who stated a desire to maintain the current LNWR regulation schedule with no structural changes except those already included in the 2050 Base. In contrast, AET members have recommended modeling and evaluation of rainfall-based operational rules as well as structural changes that would reduce drying in the northern part of the refuge and create conditions more closely resembling NSM. To date, only the current regulation schedule for LNWR has been modeled, whereas rainfall-based operations have been incorporated into all future scenarios for the remainder of the WCA system, for ENP, for Rotenberger WMA, and in all models except Alternative 2 for Holey Land WMA. Since the regulation of LNWR influences hydrology elsewhere in the Everglades, the planning team favors using restoration objectives and operational rules that are consistent throughout the Everglades system; current performance measures for LNWR reflect this goal. However, recognizing that there is a need to evaluate Restudy alternatives relative to current refuge management objectives; the team recommended that LNWR staff be asked to submit additional performance measures that could be used in combination with existing ones.

WCA-2A

Performance Based Comments:

WCA-2A has a problem with the timing of water deliveries, with too high of high water during the wet season and the wettest years, and too low of low water during dry periods. In the north, water rises earlier in the wet season and recedes faster in the dry season than in NSM. In the south, the wet season average high is approximately 0.3 ft higher than NSM while the average dry season low is approximately 0.2 ft lower than NSM. This pattern is similar to the 2050 Base but somewhat deeper overall than the 1995 Base. Year-to-year fluctuations also exceed those of NSM, with the interannual standard deviation of Alternative 2 being about 1.5 times that of NSM throughout the year in the south, and similarly about 1.5 times that of NSM during the dry season in the north.

These timing problems are reflected in the other performance measures for WCA-2A. Hydroperiods in Alternative 2 are overall about 3-5% shorter than NSM and similar to the 2050 Base. In the north (Indicator Region 25) inundation periods are fewer than NSM but of longer duration, while in the south (Indicator Region 24) they are more numerous but shorter. Despite these shorter hydroperiods, peak depths during high water years exceeded 2.5 ft in southern WCA-2A, whereas NSM did not exceed this depth. Alternative 2 peak depths are similar to the 2050 Base but deeper than the 1995 Base. During low water periods in both north and south WCA-2A, depths fall below -1.0 ft as well as below the NSM lows on several occasions. Again, Alternative 2 is similar to the 2050 Base; however, low water events are not as extreme as in the 1995 Base.

Performance Measures Used:

The Performance Measures used were those for Indicator Regions 24 and 25. (Note: because the programming for these measures is not yet complete, depth differences had to be visually estimated from graphs; hence, the numerical values reported above could change in future evaluation cycles when more precise results are available.)

1. Inundation Duration. Mean hydroperiod, number of inundation events, and mean duration of inundation were compared for match with NSM values.
2. Extreme High Water (protection of tree islands). The frequency and duration of events in which depths exceeded 2.5 ft were estimated, with a planning target of zero exceedences of the criterion.
3. Extreme High Water (NSM flood levels). The frequency and duration of high-water periods in which depths exceeded NSM values were estimated, with a planning target of zero exceedences of NSM values.
4. Extreme Low Water (protection of peat soils). The frequency and duration of events in which depths fell below -1.0 ft were estimated, with a planning target of zero exceedences of the criterion.
5. Extreme Low Water (NSM low water levels). The frequency and duration of low-water periods in which depths fell below NSM minima were estimated, with a planning target of zero exceedences of NSM values.

6. Timing of high and low stages. The weeks in which annual average high water and annual average low water occurred were compared to NSM, with a planning target of matching NSM timing.
7. Interannual variation in weekly mean depth. The weeks having the highest and lowest values of the interannual standard deviation in mean weekly depth were estimated, with a planning target of matching NSM timing and approximate matching of NSM magnitude.

Performance Indicators Used:

1. Normalized Weekly Stage Hydrograph for Indicator Regions 24 and 25
2. Temporal Variation in Mean Weekly Stage for Indicator Regions 24 and 25
3. Inundation Pattern (1965-1995) for Indicator Regions 24 and 25
4. Stage Duration Curves for Indicator Regions 24 and 25
5. Stage Duration Curve at Gage 2-17

Recommendations:

1. WCA-2A needs improved timing of water deliveries and a "flatter" stage duration curve, especially in the southern part of the area. Specific recommendations are: (1) lower wet season high water; (2) higher dry season low water; and (3) an approximate 5% increase in hydroperiod. These changes potentially could be achieved by increasing regional storage in the EAA to provide both wet season/wet year flood attenuation and dry season deliveries.

WCA-2B

Performance Based Comments:

WCA-2B exhibits an extreme version of the same problems seen in WCA-2A, but with overall deeper water. WCA-2B's hydroperiod is too short (11% shorter than NSM), yet water is too deep, with wet season average highs approximately 1.5 ft deeper than NSM. The hydroperiod is similar but depths are less extreme than in the 2050 Base (wet season high about 0.3 ft less than 2050 Base). During wet years, depths exceed 2.5 ft for very long periods in Alternative 2, sometimes even exceeding 5.0 ft. At the other extreme, dry-outs go below NSM minima by as much as 1-2 ft; and dry-outs below -1.0 ft occur in approximately 9 out of 31 years. The interannual standard deviation is approximately 2.5 to 3 times as large as that of NSM. Taken together these measures show that WCA-2B continues to show an extreme deviation from natural Everglades hydropatterns.

Performance Measures Used:

The Performance Measures used were those for Indicator 23.
(Note: because the programming for these measures is not yet complete, depth differences had to be visually estimated from graphs; hence, the numerical values reported above could change in future evaluation cycles when more precise results are available.)

1. Inundation Duration. Mean hydroperiod, number of inundation events, and mean duration of inundation were compared for match with NSM values.

2. Extreme High Water (protection of tree islands). The frequency and duration of events in which depths exceeded 2.5 ft were estimated, with a planning target of zero exceedences of the criterion.
3. Extreme High Water (NSM flood levels). The frequency and duration of high-water periods in which depths exceeded NSM values were estimated, with a planning target of zero exceedences of NSM values.
4. Extreme Low Water (protection of peat soils). The frequency and duration of events in which depths fell below -1.0 ft were estimated, with a planning target of zero exceedences of the criterion.
5. Extreme Low Water (NSM low water levels). The frequency and duration of low-water periods in which depths fell below NSM minima were estimated, with a planning target of zero exceedences of NSM values.
6. Timing of high and low stages. The weeks in which annual average high water and annual average low water occurred were compared to NSM, with a planning target of matching NSM timing.
7. Interannual variation in weekly mean depth. The weeks having the highest and lowest values of the interannual standard deviation in mean weekly depth were estimated, with a planning target of matching NSM timing and approximate matching of NSM magnitude.

Performance Indicators Used:

1. Normalized Weekly Stage Hydrograph for Indicator Region 23
2. Temporal Variation in Mean Weekly Stage for Indicator Region 23
3. Inundation Pattern (1965-1995) for Indicator Region 23
4. Stage Duration Curves for Indicator Region 23

Recommendations:

1. WCA-2B needs overall reduced depths and better timing, with a “flatter” and lower stage duration curve. Peak depths during the wettest years should be about 2.5 ft lower and average wet season highs about 1.5 ft lower than in Alternative 2. Similarly, lows during dry years should be about 1.0 ft higher than in Alternative 2. Overall, the hydroperiod needs to be about 10% longer if NSM-like hydrology is to be achieved.
2. Possible ways to accomplish this include: (1) installation of a water control trigger in WCA-2B, (2) structural changes to convey wet season water to the west and south, (3) increased seepage control to reduce dry season losses, (4) increased regional storage to provide dry season water deliveries, or (5) if all else fails, sacrificing a part of the conservation area for seepage control, but only so long as this provides for hydrological restoration of the remaining area.
3. Some team members felt that the hydrographs for the 1995 Base were unrealistic representations of conditions in WCA-2B. After some discussion, the AET therefore recommended that the modeling team be consulted about the accuracy of model output in WCA-2B before further components are evaluated.

WCA-3A
Performance Based Comments:

In general, WCA-3A is much improved over the 1995 Base, but little different than the 2050 Base. Its main problem is a poor distribution of water between the east and west, with too much water in the east, especially in the vicinity of Indicator Region 19 and along the northern reaches of the L-67 levees, and too little water in the west, with continued deep dry-outs in the northwest (Indicator Regions 20, 22) and over-drainage of central WCA-3A south of Alligator Alley (Indicator Region 17).

In northwest WCA-3A (north of Alligator Alley and west of the Miami Canal, Indicator Regions 20 and 22), hydroperiods average 2-4 % shorter in Alternative 2 than in NSM (89% vs. 93% in Region 20; 92% vs. 94% in Region 22). There is little change from the 2050 Base but about a 9% increase (= improvement) in hydroperiod over the 1995 Base. The central problem for northwest WCA-3A is that it still experiences too-frequent extreme low water. Region 20 drops below -1.0 ft approximately eight times, and minima fall below those seen in NSM. The extreme northwest corner of WCA-3A (Region 22) has similar but less severe dry-outs. Wet season depths decline faster in Alternative 2 than in NSM and reach an average low that is approximately 0.5 ft lower than NSM in Region 20 and approximately 0.1 ft lower than NSM in Region 22. Overall, northwest WCA-3A shows very slight improvement relative to the 2050 Base. Hence, the area still remains at risk of destructive muck fires, a situation especially undesirable because of the extensive damage to soils and tree islands that has already occurred in northern WCA-3A as a consequence of over-drainage in the past.

In contrast to northwestern WCA-3A, northeastern WCA-3A (north of Alligator Alley and east of the Miami Canal, Indicator Region 21) is too wet in Alternative 2. The average hydroperiod is 7% longer than NSM (Alternative 2 = 91% vs. NSM = 84%). This is slightly wetter than the 2050 Base (89%) and much wetter than the 1995 Base (hydroperiod = 74%). Overall dry season average depths exceeded NSM by approximately 0.5 ft, similar to both the 2050 and 1995 Bases. Alternative 2 is similar to all other future scenarios in providing no reduction in flooding in this area. During the high water year of 1994, Alternative 2 exceeded 2.5 ft in depth whereas NSM did not, similar to the 1995 and 2050 Bases. This has adverse implications for wading bird nesting in the conservation areas, since the actual high water that occurred during 1994-95 led to the loss of an estimated 75% of the willows in the Rescue Strand rookery in northeast WCA-3A. Rescue Strand was one of the Everglades' most productive rookeries in recent years, and until suitable wading bird habitat is restored elsewhere in the system, it is important to avoid recurrences of such events. It is also noteworthy that although northeast WCA-3A overall is too wet in Alternative 2, its dry season depths still fall below -1.0 ft about 4% of the time; hence despite greater-than-NSM depths, there remains considerable potential for damaging peat fires in the area.

In eastern WCA-3A (south of Alligator Alley and east of the Miami Canal, Indicator Region 19), water is too deep for too long. The average hydroperiod in Alternative 2 is 9% longer than in NSM (Alternative 2 = 97% vs. NSM = 89%). Although this is an improvement over the even wetter conditions in the 1995 Base (hydroperiod = 99%), it is a shift in the wrong direction compared to the 2050 Base (hydroperiod = 95%). Overall, depths exceed NSM year round, with wet season depths averaging approximately 1.0 ft higher than NSM. In the wettest

years depths exceeded NSM by up to 2.0 ft, and depths greater than 2.5 ft occurred several times during the simulation.

In southern WCA-3A (south of Alligator Alley, west of the Miami Canal, Indicator Regions 14, 17 and 18), hydrology is much improved over the 1995 Base but little changed from the 2050 Base. Average hydroperiods in general match NSM. However, there are two significant problems that remain in this area. The first is that water depths during flood years are still too high. In the far south (Region 14), depths exceed 2.5 ft on several occasions, and exceed NSM peak depths during the wettest years. During the 1994-95 high water period, Alternative 2 sustained depths of 3-5 ft in all three indicator regions, whereas NSM never exceeded 2.5 ft except briefly in Region 14. This is of concern since it takes no more than a single sustained high-water event to do major, and possibly lasting, damage to tree islands. Although the deviation from NSM flooding patterns in 1994-95 is most pronounced in southern WCA-3A, it is evident in other indicator regions throughout the conservation area, as well as in WCA-3B. This contrasts sharply with the pattern seen during the same period in Shark River Slough in ENP (Indicator Regions 9-11), where depths remained below flood levels predicted by NSM throughout 1994-95. All alternatives considered to date, as well as the 2050 Base, exhibit this behavior during 1994-95, which suggests that the water management components considered so far are not yet sufficient to convey flood-year flows efficiently out of the conservation areas and to the south, where they could flow unimpeded into Florida Bay.

A second problem in southern WCA-3A is the over-drainage of south-central WCA-3A (Indicator Region 17), which occurs in Alternative 2 as well as in the 2050 Base, Starting Point and Alternative 1. This area, together with the area immediately to the north (Indicator Region 18), is the part of the northern Everglades that has been least affected by impoundment of the conservation areas and that is believed to most resemble the pre-drainage landscape of the area. Unfortunately, Alternative 2 is substantially drier than the 1995 Base, with a median depth about 0.5 ft lower and a hydroperiod 5% shorter than 1995 Base. Such conditions would be expected to cause undesirable vegetation changes in this portion of the Everglades, creating a hydrology more suitable for wet prairie or sawgrass plains landscapes than for the ridge-and-slough vegetation communities that are presently, and were historically, found there. One reason for the drying of this area in the future scenarios is likely to be the NSM hydrograph used to "trigger" water management in the models. The hydrology in Indicator Region 17 does, in fact, match NSM; however, the NSM depth pattern is shallower here than in all other indicator regions within the historical ridge-and-slough landscapes of WCAs 2 and 3 (Regions 14-20,22-25), including the indicator regions immediately up- and downstream from Region 17. This suggests that the NSM "target" for this region would be more suitably defined using a "rescaled" NSM hydrograph more similar to those of nearby ridge-and-slough areas.

Finally, comments on Alternative 2 pointed out that the changes in ponding patterns expected under Alternative 2 have implications for wide-ranging species, such as snail kites and wading birds, that require particular ranges of depth for successful foraging and reproduction. Reduction of ponding in southern WCA-3A will provide improved conditions for tree islands, but it may impact snail kite populations if suitable deeply ponded areas are not restored elsewhere in the system, such as in Shark River Slough. Similarly, wading birds require a broad range of ponding depths to provide foraging throughout the year, and also depend on the

existence of deeply ponded areas to provide dry season refugia for the aquatic organisms on which they feed. This range of depths has existed in WCA-3A in recent years, and until it is clear that this type of hydrological pattern can be restored in Shark Slough, it will be important to insure that suitable conditions for wading bird breeding persist in the northern Everglades. In Alternative 2, ponding in northern WCA-3B may compensate for some of the lost areas of deep ponding in southern WCA-3A; however implications for tree island communities also need to be evaluated in any area subject to deep ponding.

Performance Measures Used:

The Performance Measures used were those for Indicator Regions 14 and 17-22. (Note: because the programming for these measures is not yet complete, depth differences had to be visually estimated from graphs; hence, the numerical values reported above could change in future evaluation cycles when more precise results are available.)

1. Inundation Duration. Mean hydroperiod, number of inundation events, and mean duration of inundation were compared for match with NSM values.
2. Extreme High Water (protection of tree islands). The frequency and duration of events in which depths exceeded 2.5 ft (or 2.0 ft, Indicator Region 21 only) were estimated, with a planning target of zero exceedences of the criterion.
3. Extreme High Water (NSM flood levels). The frequency and duration of high-water periods in which depths exceeded NSM values were estimated, with a planning target of zero exceedences of NSM values.
4. Extreme Low Water (protection of peat soils). The frequency and duration of events in which depths fell below -1.0 ft were estimated, with a planning target of zero exceedences of the criterion.
5. Extreme Low Water (NSM low water levels). The frequency and duration of low-water periods in which depths fell below NSM minima were estimated, with a planning target of zero exceedences of NSM values.
6. Timing of high and low stages. The weeks in which annual average high water and annual average low water occurred were compared to NSM, with a planning target of matching NSM timing.
7. Interannual variation in weekly mean depth. The weeks having the highest and lowest values of the interannual standard deviation in mean weekly depth were estimated, with a planning target of matching NSM timing and approximate matching of NSM magnitude.

Performance Indicators Used:

1. Normalized Weekly Stage Hydrograph for Indicator Regions 14,17-22
2. Temporal Variation in Mean Weekly Stage for Indicator Regions 14,17-22
3. Inundation Pattern (1965-1995) for Indicator Regions 14,17-22
4. Stage Duration Curves for Indicator Regions 14,17-22
5. Stage Duration Curve at Gage 3A-4
6. Ponding Depth Maps
7. Ponding Depth Difference Maps
8. Peak Stage Difference Maps

Recommendations:

1. There is a need to redistribute water deliveries into WCA-3A toward the west, to provide increased depths in northwestern and west-central WCA-3A, especially during the dry season, and reduced depths in eastern WCA-3A.
2. Relative to Alternative 2, the specific hydrological changes needed are: (1) in northeast WCA-3A, a reduction in dry season depths of about 0.25 ft, with no increase in the frequency of dry-outs below -1.0 ft; (2) in eastern WCA-3A, a year-round depth reduction of approximately 1.0 ft, with greater reductions during peak wet years; (3) in northwest WCA-3A, an increase in dry season lows of about 0.5 ft; and (4) in central WCA-3A, increased deliveries to avoid over-drainage.
3. To avoid over-drainage in central WCA-3A, it will probably be necessary to adjust NSM trigger depths at the 3A-4 gage. In general, suitable redistribution of water could be accomplished using increased storage within the EAA to provide for dry season deliveries and improved conveyance to the south.
4. The infrequent but unnaturally high water levels seen in 1994-95 need to be prevented. There is an evident need for better conveyance of water to the south during high flow periods; it may also be necessary to increase northern storage in order to attenuate flood waters before they enter the Everglades system.

WCA-3B

Performance Based Comments:

WCA-3B is too deep in the west and north in Alternative 2. The average hydroperiod in western WCA-3B is 97%, which is 4% longer than NSM, 6% longer than the 2050 Base, and 2% longer than the 1995 Base. Depths exceeded 2.5 ft on approximately ten occasions, and peak stages were higher in Alternative 2 than in any of the other simulations in almost every year. In the north, depths exceeded NSM by about 1.0 ft almost continuously. During the 1994-95 high water event, depths exceeded 3-4 ft for durations of several months; this is deeper than the 2050 Base and much deeper than the 1995 Base.

In southeastern WCA-3B, performance indicators suggest that depths are much shallower than in the west and north. However, there is concern about the accuracy of the SWFMM output in this area, owing to a deviation in the topographic model for the far southeastern corner; here, the SFWMM assumes an elevation of 6.4 ft NGVD, whereas recent marsh transects indicate an average depth near the 3B-SE gage of 5.5 ft NGVD. Hence, depth comparisons between the SFWMM and NSM may not be meaningful in this area, and for this reason output from Indicator Region 16 was not used for evaluations.

Performance Measures Used:

The Performance Measures used were those for Indicator Region 15 only.
(Note: because the programming for these measures is not yet complete, depth differences had to be visually estimated from graphs; hence, the numerical values reported above could change in future evaluation cycles when more precise results are available.)

1. Inundation Duration. Mean hydroperiod, number of inundation events, and mean duration of inundation were compared for match with NSM values.
2. Extreme High Water (protection of tree islands). The frequency and duration of events in which depths exceeded 2.5 ft were estimated, with a planning target of zero exceedences of the criterion.
3. Extreme High Water (NSM flood levels). The frequency and duration of high-water periods in which depths exceeded NSM values were estimated, with a planning target of zero exceedences of NSM values.
4. Extreme Low Water (protection of peat soils). The frequency and duration of events in which depths fell below -1.0 ft were estimated, with a planning target of zero exceedences of the criterion.
5. Extreme Low Water (NSM low water levels). The frequency and duration of low-water periods in which depths fell below NSM minima were estimated, with a planning target of zero exceedences of NSM values.
6. Timing of high and low stages. The weeks in which annual average high water and annual average low water occurred were compared to NSM, with a planning target of matching NSM timing.
7. Interannual variation in weekly mean depth. The weeks having the highest and lowest values of the interannual standard deviation in mean weekly depth were estimated, with a planning target of matching NSM timing and approximate matching of NSM magnitude.

Performance Indicators Used:

1. Normalized Weekly Stage Hydrograph for Indicator Regions 15 and 16
2. Temporal Variation in Mean Weekly Stage for Indicator Regions 15 and 16
3. Inundation Pattern (1965-1995) for Indicator Regions 15 and 16
4. Stage Duration Curves for Indicator Regions 15 and 16
5. Normalized Stage Duration Curves for R23C26, R24C25, R25C25, R26C24, R27C25, and R26C26
6. Ponding Depth Maps
7. Ponding Depth Difference Maps
8. Peak Stage Difference Maps

Recommendations:

1. WCA-3B needs to be shallower. Specific recommendations are to reduce peak depths in northern WCA-3B by about 1.0 ft, and to reduce average wet season highs in Region 15 by about 0.4 ft. The recommended way to achieve this is to provide appropriate and abundant conveyance of water from the conservation areas to ENP in such a manner that NSM depths can be achieved in Shark Slough without leading to excessive ponding in WCA-3B or over-drainage of WCA-3A.
2. The topographic data issue for southeastern WCA-3B needs to be evaluated. Specifically, the subteam asks that the modeling team review the topography for NSM and SFWMM cells in southeast WCA-3B and advise the AET as to (1) the expected validity of comparing NSM

and SFWMM depths in this area, and (2) possible effects that topographical assumptions may be exerting on hydrology.

Pennsuco Wetlands
Performance Based Comments:

The hydroperiod at R26C27 is 94%, which is a substantial improvement over the too-short (81%) hydroperiods of the 2050 Base and the 1995 Base; however, it still overshoots the NSM hydroperiod of 87%. Alternative 2 depths continue to exceed NSM depths in the north.

Performance Measures and Indicators Used:

1. Normalized Stage Duration Curve for R26C27
2. Normalized Stage Hydrograph for R26C27
3. Ponding Depth Maps
4. Ponding Depth Difference Maps

Recommendations:

1. Reduce median depths in northern Pennsuco by approximately 0.5 -0.8 ft, without reducing the hydroperiod by more than 5%.

F. Southern Everglades (Everglades National Park, Model Lands)

Northeast Shark Slough
Performance Based Comments:

Under Alternative 2, the majority of overland flows are still shunted to the west rather than into NESRS. Alternative 2, like Alternative 1, is worse than the Starting Point in frequency of drydowns. As with the Starting Point and Alternative 1, Alternative 2 approaches, but still falls short of NSM. Alternative 2 resulted in water depths that were lower overall than NSM. Under Alternative 2, the number of drydowns in NESRS is nine times greater than predicted by NSM. This frequency of drydowns in historic Shark Slough will continue to demonstrably lower standing crops and alter community composition of fishes and aquatic invertebrates and to cause loss of peat soils. Melaleuca expansion will continue to progress westward into the slough because of overdrainage, resulting in shorter hydroperiods. The subteam had expected to see an improvement over the Starting Point in this region, because increased conveyance capacity under L-29 and the Tamiami Trail, as well as elevation of the road bed, were modeled in Alternative 2.

Concern: Increased ponding depths and longer hydroperiods in the eastern areas of Everglades National Park are a critical component of ecological restoration for the Restudy. Current models are not delivering the necessary water to this region.

Performance Measures and Indicators Used:

1. Normalized Stage Duration Curve at NESRS-2 (R21, C24)
2. Average Annual Overland Flow south of Tamiami Trail, East of L-67E
3. Average Annual Hydroperiod Differences
4. Ponding Depth Differences
5. Inundation Duration Figure and Table (# of Events), Region 11
6. Region 11 Stage hydrographs and stage duration curves
7. Gauge NESRS-1 and Gauge NESRS-2 stage hydrographs and duration curves
8. 2-gage Average Import Stage Duration Curves for NESRS, NESRS-1 and NESRS-2
9. Average Monthly Overland Flows South of Tamiami Trail East and west of L-67 Extension

Recommendations:

1. The subteam strongly recommends that more water is moved into this area of Everglades National Park and that hydroperiods and ponding depths become more similar to those in NSM.
2. More storage is recommended in the EAA (or in model space if no geographic area is yet delineated) to provide enough water for improving water deliveries to Northeast Shark Slough.
3. The subteam recommends that Alternative 2 incorporate seepage control strategies, such as buffer lands and limited curtain walls where development has occurred directly adjacent to protected natural areas.
4. Alternative 3 should reduce the number of drydowns.

Shark Slough
Performance Based Comments:

In a dry year NSM predicts a persistent pool aligned along the main stem of the historic Shark Slough in accordance with natural topographic contours. The pattern of dry season pooling evident in Alternative 2 (as in Alternative 1) is similar to that seen today, with dry season ponding occurring in WCA-3 and with values lower than NSM south of Tamiami Trail. The cessation of sufficient overland flow into Shark Slough has resulted in the reduction or elimination of persistent pooling, as well as increased frequency of drydowns, affecting survival and productivity of aquatic organisms.

Average monthly and annual overland flows to Everglades National Park show higher volumes of water going south of Tamiami Trail under Alternative 2 when compared with Alternative 1. Alternative 2 also shows higher volumes of water going west of the L-67 extension canal. Why is not more of that flow being diverted to the east where there is a serious need for water to achieve restoration?

Alternative 2 consistently failed to meet NSM. Hydroperiods and flows predicted by Alternative 2 were lower than NSM. In dry years, Alternative 2 indicated that Shark Slough dried for as much as three months longer than under NSM. This would be devastating to aquatic communities.

Performance Measures and Indicators Used:

1. Stage Duration Curve (NP-201) North Shark Slough
2. Stage Duration Curve (P-33)
3. Stage Duration Curve (G620)
4. Stage Duration Curve (NP-34)
5. Stage Duration Curve (NP-36)
6. Stage Duration Curve (NP-38)
7. Hydroperiod Differences
8. Inundation Duration Figures and Table (# of Events); Regions 9,10, 12
9. Indicator Regions 7, 10, and 12, average annual hydroperiods and ponding depths
10. Indicator Region 10 ponding depths
11. Average Monthly Overland Flows South of Tamiami Trail, West of L-67 extension to ENP
12. Stage Duration Curves for SW Shark River Slough (Region 9)

Recommendation:

1. The ADT should explore using the lowest management-intensive strategy to establish rainfall-based flows. These flows must extend from the upper to the lower reaches of the Everglades catchment area in sufficient volume to maintain dry season pool formations that persist within the downstream reaches of the system, with hydropatterns similar to those predicted by NSM.

Rocky Glades/Eastern Marl Prairies
Performance Based Comments:

Although Alternative 2, like Alternative 1, provided some improvement over the various base cases, it fell significantly short of restoration targets when compared with NSM. NSM predicts relatively longer hydroperiods than the 1995 Base and both of the alternatives to date. Ponding depth differences indicate a difference in Alternative 2 compared with NSM of + 0.5 ft, whereas stage duration curves show a difference of 2 ft. Subsurface water levels during the dry season are significantly lower than predicted for NSM; this has serious consequences for solution hole refugia.

Performance Measures and Indicators Used:

1. Marsh Stage Duration Curve (G-596)
2. Marsh Stage Duration Curve (G-1502)
3. Average Annual Hydroperiod Differences
4. Ponding Depth Differences
5. Inundation Duration Figure and Table (# of Events), Region 8
6. Indicator Regions 1, 8, average annual hydroperiods and ponding depths
7. Stage Duration Curves (Region 8)

Recommendations:

1. Ecological restoration will require longer continuous hydroperiods, greater ponding depths (both above and below ground), and more frequent occurrence of multi-year continuous inundation.
2. A priority should be placed on moving an adequate amount of water to this area.

Taylor Slough
Performance Based Comments:

The model outputs provided for Taylor Slough were not adequate for analysis. Output from additional gauges is needed and was requested at the AET meeting. Analysis of available output (NP-207) suggested that Alternative 2 did not differ significantly from other alternatives and that ponding depths and hydroperiods for the alternatives and bases were similar to NSM.

Performance Measures and Indicators Used:

1. Annual Average Hydroperiod Differences
2. Ponding Depth Differences
3. Stage Duration Curves (NP-207), (Cell R8 C29)
4. Inundation Duration Figure and Table (# of Events), Region 1
5. Indicator Region 1 average annual hydroperiods and ponding depths
6. Weekly Stage Duration Curves for Taylor Slough, Region 1

Recommendation:

1. Alternative 3 should better approximate NSM depth and hydroperiod patterns.

C-111
Performance Based Comments:

Alternative 2, like Alternative 1, shows that there are 1.5 times the number of drydown events in Indicator Region 4 as predicted by NSM. This increased frequency of drydowns has a substantial negative effect on the survival and productivity of aquatic organisms, and on associated ecological processes. Under Alternative 2, the simulation eliminated the natural variability in dry season water levels apparent under NSM.

Concern: No effort has been made to model changes that would occur if fragmentation of this area by canals, etc. was reduced.

Performance Measures and Indicators Used:

1. Stage Duration Curve (G-1251)
2. Annual Average Hydroperiod Differences
3. Ponding Depth Differences
4. Inundation Duration Figure and Table (# of Events), Region 4
5. Stage Duration Curves (Region 4)

Recommendations:

1. Restoration strategies for the C-111 basin must reduce the frequency of drydown events as evident in Alternative 2.
2. Sheetflow must be reestablished in the C-111 Basin, including filling in canals, ditches, and culvert pools to reduce colonization opportunities by exotic organisms, and to eliminate artificially large, deep water habitats that result in changes in species composition and energy flow in the adjacent wetlands.

Model Lands

Performance Based Comments:

Water depths and hydroperiods are more than double those under NSM (for Region 6) compared with Alternative 2 and base conditions. The natural variability in stage is also eliminated under Alternative 2.

Concerns: All alternatives, including Alternative 2, demonstrate that the Model Lands remain hydrologically isolated, producing conditions that do not approximate NSM conditions. The basin is closed and ecologically degraded, lacking connections with adjacent wetlands to the west. The significant reduction in spatial extent of the historic natural system requires that efforts be made to restore these wetlands.

Performance Measures and Indicators Used:

1. Stage Duration Curves (R8, C29)
2. Annual Average Hydroperiod Differences
3. Ponding Depth Differences
4. Inundation Duration Figures and Tables (# of Events), Regions 5, 6
5. Stage Duration Curves for Model Lands South (Region 5)
6. Stage Duration Curves for Model Lands North (Region 6)
7. Hydroperiod matches/improvements

Recommendation:

1. Explore strategies to improve the timing and distribution of water deliveries to the Model Lands.

Subteam Issues:

Alternative 2 shows no substantive changes over Alternative 1 that move toward ecological restoration of the system. Alternative 2 falls short of NSM over most of the region. The Southern Everglades subteam recommends that a comprehensive strategy for ecological restoration be developed and implemented in one of the next alternatives. The maximum that can be achieved for ecological restoration needs to be modeled, possibly by suspending some rules for the modeling effort. The subteam recommends a plan that includes recommendations presented in earlier discussions, such as the 1984 memorandum that introduced the 7-Point Plan

proposed by Everglades National Park. This model run would include the degradation of levees and filling of canals, establishment of a rainfall-driven system, and the reestablishment of sheetflow. A general assessment of Alternative 2 indicated that a number of structures (e.g., curtain walls and new structures) have been added, but conversely, the beneficial activity of the removal of structure and canals was not evident. Alternative 2 did not appear to greatly advance the majority of hydrological restoration objectives promoted by the 7-Point Plan, and subsequent documents. The subteam recommends future alternatives incorporate modifications to address these concerns. The multi-agency team of hydrologists and engineers should look for innovative solutions to hydrological and ecological restoration, because it is clear that current strategies are not doing enough for restoration of the Everglades.

Needed model outputs for future alternative assessments:

1. It is suggested that the new hydrologic performance indicators suggested by Everglades National Park be made available to Web users as soon as possible.
2. There were not adequate hydrologic performance indicators to analyze Taylor Slough and the Rocky Glades. Output is requested for:
    a. NP-44 and Craighead Pond
    b. Weekly or Monthly Hydrographs for 1989, 1991, and 1995 for the following: stations NP-205, NP-44, P-33, NESRS-1, NP-206, NTS-1, R3110, and Craighead Pond
    c. Stage Duration Curves for the following stations: NP-205, NP-44, NESRS-1, NP-206, NTS-1, R3110, and Craighead Pond
    d. Region-wide Ponding Depth maps for May and October for the following years: 1989, 1991, and 1995
    e. Hydroperiod Difference maps for alternative v. NSM for the year 1991

G. Estuaries and Bays

Caloosahatchee Estuary
Performance Based Comments:

The number of times low flow discharges were not met decreased with the Alternative 2, as compared to the Starting Point, 2050 Base, and Alternative 1, but the target (300 cfs) still has not been reached. A base flow of 300 cfs is needed to maintain appropriate salinities. No regulatory releases from Lake Okeechobee are desired. The number of regulatory releases to the Caloosahatchee Estuary is still high (18). However, Alternative 2 decreased the number of months that the total monthly inflow from the C-43 basin exceeded 2,800 cfs and 4,500 cfs as compared to the 2050 Base, 1995 Base, Alternative 1 and the Starting Point.

Performance Measures and Indicators Used:

1. Number of times salinity envelope criteria were not met for the Caloosahatchee Estuary

2. Number of times high discharge criteria (mean monthly flow > 2,800 and 4,500 cfs) were exceeded for the Caloosahatchee Estuary

Recommendations:

1. Continue to move toward the targets of no regulatory releases, as well as the low flow (<300 cfs) and high flow (>2,800 cfs) targets of 60 and 22, respectively.
2. The Lower West Coast Planning Division of the SFWMD could provide an operational rule for a storage facility in the C-43 basin. The operational rule was developed using the Optimization model and the period of record rainfall.
3. The stage hydrograph in C-43 basin indicates that there may be opportunities to capture more excess runoff within the basin if the reservoir could accommodate additional storage.

St. Lucie Estuary
Performance Based Comments:

A base flow of 350 cfs is needed to maintain appropriate salinities in the estuary. The increased size of the C-44 reservoir in Alternative 2 only slightly improved base flow to the estuary. Total monthly flows to the estuary which exceed 1,600 cfs for more than 14 days cause undesirable salinity fluctuations in the estuary. No regulatory releases from Lake Okeechobee are desired and regulatory releases have been eliminated. However, the number of high discharge events was only slightly decreased with the larger C-44 reservoir incorporated in Alternative 2, as compared to Alternative 1. It appears that the influence from the other tributary basins, C-23, C-24, North Fork and South Fork, overshadow the effects of the larger storage facility in the C-44 basin. Overall, Alternative 2 did not display much difference from Alternative 1 and a substantial amount of improvement is needed to attain the targets.

Performance Measures and Indicators Used:

1. Number of times salinity envelope criteria were not met for the St. Lucie Estuary
2. Number of times high discharge criteria (mean monthly flow > 1,600 & 2,500 cfs) were exceeded for St. Lucie Estuary

Recommendation:

1. Continue moving toward meeting targets for low (<350cfs) and high (>1,600cfs) flows of 50 and 13 months, respectively. The ADT needs to look at the other tributary basins (C-23, C-24, North Fork and South Fork) to make further reductions in high discharges and to contribute towards meeting minimum base flows.

Lake Worth Lagoon
Performance Based Comments:

The C-51 performance criteria indicated that Alternative 2 slightly decreased the amount of water to Lake Worth Lagoon as compared to the 2050 Base, Alternative 1, and the Starting Point. The target is to meet minimum flow to the Lake Worth Lagoon (150 cfs).

Performance Measure Used:

1. Wet/Dry Season Average Flows Discharged to Lake Worth through S40, S41 & S155 for the 31 year Simulation

Biscayne Bay:
Performance Based Comments:

The Starting Point reduces wet season flows to Biscayne Bay by > 40% and dry season flows by > 50%. Alternative 2 provides almost the same amount of water to Biscayne Bay as in Alternative 1, except in the Miami River and Snake Creek areas. In both these areas there is a decrease of water as compared to Alternative 1. However, Alternative 2 still provides much less water than either the 2050 Base or 1995 Base. In this regard, Alternative 2 has not moved Biscayne Bay toward the goal of more estuarine conditions.

Performance Measure Used:

1. Simulated mean annual surface flows discharged into Biscayne bay for the 1965-1995 simulation period

Recommendation:

1. Improve estuarine conditions by increasing water flow to Biscayne Bay. At the minimum, try and reestablish the 1995 Base flow to Biscayne Bay.

Florida Bay and Coastal Basins
Performance Based Comments:

In comparison to Alternative 1, Alternative 2 had a minor positive influence on salinity in the coastal basins of Florida Bay, as simulated by salinity/P33 stage regressions. The frequency of undesirable high-salinity events decreased slightly, and the frequency of desirable low-salinity events increased slightly in the coastal basins. Benefits to the coastal basins from Alternative 2 are similar to, but slightly less than, those realized by the Starting Point. Both Alternative 2 and the Starting Point represent approximately half the progress that is required to accomplish the salinity objectives for ecological restoration of the coastal basins of Florida Bay.

The multiple-station average salinity for Florida Bay, as simulated by the Florida Bay Ecosystem Model, is nearly identical for NSM conditions and Alternative 2. Frequencies of high and low salinity events in Florida Bay are similar for Alternative 2 and NSM. The multiple-station average includes interior basins in Florida Bay which apparently have been influenced less by water management than the coastal basins, thus the closer resemblance of multiple-station salinity to NSM.

P33 stages above 6.3 ft msl correspond to coastal basin salinities below the levels that indicate undesirable high salinity events for each basin. There are approximately 73 months of

the period of record when NSM4.5 exceeds that stage, but Alternative 2 does not, which is a slight improvement over the 79 months in Alternative 1. These events occurred in the November-May dry season during 26 years, and in the June-October wet season during 15 years of the 31-year period of record.

P33 stages above 7.3 ft msl correspond to coastal basin salinities below the levels that indicate desirable low salinity events for each basin. There are approximately 28 months of the period of record when NSM4.5 exceeds that stage, but Alternative 2 does not, which is a slight improvement over the 32 months in Alternative 1. These events occurred in the November-May dry season during six years, and in the June-October wet season during ten years of the 31-year period of record.

The rockland marl marsh (Indicator Region 8) represents the higher elevation marshes in the marl prairie/rocky glades landscape. This indicator region has been chosen for detailed analysis of performance measures for the landscape because it shows the largest deviation from the NSM in Alternative 2. It also provides a potential hydrologic linkage between Shark River and Taylor Sloughs and a water head that potentially influences the hydrology of lower elevation marl marshlands and Taylor Slough.

Hydrologic performance measures for the ecological restoration of the marl prairie/rocky glades landscape include duration of flooding during periods of standing water, water depth below the ground surface during dry periods, and water depth > 6 inches during periods of standing water.

Concerning duration of flooding, the rockland marl marsh indicator region experienced periods of flooding that averaged seven months in duration under Alternative 2, compared to ten months under NSM. Two factors contributed to this difference. During typical wet season/dry season cycles, the marsh generally flooded in the same month of the wet season in both Alternative 2 and the NSM, but the marsh tended to go dry 1-3 months earlier in the dry season in Alternative 2 compared to the NSM. Prolonged periods of flooding of 17-33 months, as simulated by the NSM four times in the period of record, were broken by dry periods in Alternative 2 in three of the four events. Hydroperiods need to be extended 1-3 months longer into dry seasons, based on annual rainfall patterns, and multi-year periods of flooding need to be restored during extended high-rainfall periods.

Concerning water depth below ground during drought, during dry conditions, water levels in the rockland marl marsh dropped an average of 1.2 ft below the ground surface under Alternative 2 compared to 0.9 ft under NSM. Ground water levels need to be raised during dry periods an average of at least 0.3 feet over the period of record.

When looking at water depth > 6 inches during periods of flooding, both Alternative 2 and the NSM indicate an average water depth of ~ 0.6 ft during periods of flooding. This performance measure has been accomplished in Alternative 2.

Performance Measures and Indicators Used:

1. Salinity exceedance counts for Joe Bay, Little Madeira Bay, Garfield Bight, Terrapin Bay, North River Mouth, and Florida Bay.
2. Stage hydrograph and stage duration curves at Everglades National Park Gage NP33, Cell R17C20.
3. Inundation pattern (1965-1995) for Rockland Marl Marsh Indicator Region 8.

Recommendations:

1. Increase dry season and wet season water deliveries into NE Shark River Slough to achieve P33 stages of 6.3 and 7.3 ft msl during the months when NSM4.5 reaches those stages, but Alternative 2 does not.
2. Increase dry season deliveries into NE Shark River Slough to extend hydroperiods and raise ground water levels in the rockland marl marsh indicator region. Extend hydroperiods 1-3 months longer into the dry seasons, based on annual rainfall patterns, and restore multi-year periods of flooding during extended high rainfall periods. Raise ground water levels during dry periods at least 0.3 ft over the period of record.

TABLE 1
P33 STAGE 6.3 FT MSL

Time Equaled or Exceeded

NSM	70%
ALT 2	54%
ALT1	50%
STRTPT	57%
50BASE	42%
95BASE	34%

Approximate Periods When 6.3 Was Attained by NSM, But Not by Alt 2

1965	JAN		
1966	MAR-APR		
1967	MAR-APR	JUN-JUL	
1968	MAR		
1969	MAR-JUN		
1970			DEC
1971	JAN-FEB	SEP-OCT	DEC
1972			DEC
1973	JAN-FEB	AUG	DEC
1974	JAN	AUG	DEC
1975	JAN-FEB	AUG-SEP	
1976	FEB	JUN	
1977	FEB	AUG-SEP	
1978	JAN-FEB	JUN-JUL	
1979	MAR-MAY	JUN-AUG	
1980	MAR-MAY	JUN-AUG	

1981			DEC
1982	JAN	JUN	
1983			
1984	MAR-MAY		DEC
1985	JAN		
1986	APR	JUN	
1987	FEB	SEP	
1988	FEB	JUL	NOV
1989			
1990			NOV-DEC
1991			
1992	MAR-MAY		
1993			
1994	MAR	JUL	
1995			

TABLE 2
P33 STAGE 7.3 FT MSL

Time Equaled or Exceeded

NSM	13%
ALT2	6%
ALT1	4%
STRTPT	7%
50BASE	1%
95BASE	1%

Approximate Periods When 7.3 Was Attained by NSM, But Not by Alt 2

1965			
1966		JUL	NOV-DEC
1967		OCT	
1968		JUL	NOV
1969		JUL-SEP	
1970	JAN	JUN-OCT	
1971			
1972			
1973			
1974			
1975			
1976			
1977			
1978			
1979			
1980	JAN		

1981	SEP-OCT	
1982		
1983	JUN & AUG-SEP	
1984		
1985		
1986		
1987		
1988		
1989		
1990		NOV-DEC
1991	SEP-OCT	NOV
1992	JUL	
1993		
1994	SEP	
1995		

TABLE 3
Approximate Duration Of Flooding (Months) And Mean Depth During Flooding (Feet) For Each Flood Event During The 1965-1995 Period Of Record*

Natural System Model			Alternative 2		
Flood Events	Months	Feet	Flood Events	Months	Feet
Sep 65 - Feb 66	6	0.5	Sep 65 - Jan 66	5	0.5
May 66 - Mar 67	11	1.0	May 66 - Jan 67	9	0.8
Jun 67 - Feb 68	9	0.6	Jun 68 - Jan 68	8	0.6
May 68 - Jan 71	3	1.0	May 68 - Feb 69	10	0.8
			May 60 - Apr 70	12	0.9
			Jun 70 - Nov 70	6	0.8
Sep 71 - Oct 71	2	0.2	Sep 71 - Oct 71	2	0.2
May 72 - Feb 73	10	0.5	May 72 - Dec 72	8	0.5
Aug 73 - Dec 73	5	0.4	Aug 73 - Oct 73	3	0.4
Jun 75 – Dec 75	7	0.5	Jun 75 - Nov 75	6	0.5
May 76 – Jan 77	9	0.6	May 76 – Dec 76	8	0.6
Aug 77 – Feb 78	7	0.4	Aug 77 – Nov 77	4	0.4
Jun 78 – Feb 79	9	0.6	Jun 78 – Jan 79	8	0.5
Apr 79 – Jan 81	22	0.6	Apr 79 – Dec 79	9	0.3
			Jul 80 – Nov 80	5	0.4
Aug 81 – Jan 82	6	0.9	Sep 81 – Dec 81	4	0.7
Jun 82 – Mar 84	22	0.7	Jun 82 – Apr 83	11	0.5
			Jun 83 – Dec 83	7	0.6
Jun 84 – Nov 84	6	0.5	Jun 84 – Oct 84	5	0.4
Aug 85 – Mar 86	8	0.4	Aug 85 – Jan 86	6	0.4

Jun 86 – Nov 86	6	0.4	Jun 86 – Sep 86	4	0.4
Aug 87 – Jan 88	6	0.5	Sep 87 – Dec 87	4	0.4
Jun 88 – Oct 88	5	0.7	Jun 88 – Oct 88	5	0.7
			Aug 89 – Sep 89	2	0.2
Aug 90 – Nov 90	4	0.4	Jul 90 – Oct 90	4	0.4
May 91 – Apr 92	12	0.9	May 91 – Jan 92	9	0.9
Jun 92 – Apr 93	11	0.9	Jun 92 – Jan 93	8	0.7
Jun 93 – Apr 94	11	0.7	Jun 93 – Dec 93	7	0.5
Aug 94 – Dec 95	17	1.1	Sep 94 – Dec 95	16	1.1

	NSM	ALT 2
Approx. Total Months of Flooding*	244 months of 372	195 months
Number of Flood Events*	24	29
Approx. Mean Duration	10 months	7 months
Approx. Max Duration	33 months	16 months
Approx. Min Duration	2 months	2 months
Approx. Mean Depth During Flooding	0.6 ft	0.6 ft

* Flooding events of one month or less are not included.

TABLE 4
Approximate Duration Of Drying (Months) And Mean Depth Below Ground Surface (Feet) For Each Dry Event During The 1965-1995 Period Of Record

Natural System Model			Alternative 2		
Dry Events	Months	Feet	Dry Events	Months	Feet
Feb 65 – Aug 65	7	1.6	Jan 65 – Aug 65	8	1.9
Mar 66 – Apr 66	2	0.5	Feb 66 – Apr 66	3	0.8
Apr 67 – May 67	2	1.0	Feb 67 – May 67	4	1.3
Mar 68 – Apr 68	2	0.8	Feb 68 – Apr 68	3	1.0
			Mar 69 – May 69	3	0.5
			May 70	1	0.2
Feb 71 – Sep 71	8	1.8	Dec 70 – Sep 71	10	2.1
Nov 71 – Apr 72	6	0.8	Nov 71 – Apr 72	6	1.0
Mar 73 – Jul 73	5	1.2	Jan 73 – Jul 73	7	1.5
Jan 74 – May 75	7	1.8	Nov 73 – May 75	19	1.8
	10	0.8			
Jan 76 – Apr 76	4	0.9	Dec 75 – Apr 76	5	1.4
Feb 77 – Jul 77	6	0.8	Jan 77 – Jul 77	7	1.3
Mar 78 – May 78	3	0.3	Dec 77 – May 78	6	0.5
Mar 79	1	0.4	Feb 79 – Mar 79	2	1.1
			Feb 80 – Jun 80	5	0.8
Feb 81 – Jul 81	6	1.8	Dec 80 – Jul 81	8	1.9
Feb 82 – May 82	4	0.6	Jan 82 – May 82	5	1.2

Apr 84 – May 84		2	0.7	Jan 84 – May 84		5	1.1
Dec 84 – Jul 85		8	1.7	Nov 84 – Jul 85		9	1.8
Apr 86 – May 86		2	0.6	Feb 86 – May 85		4	0.7
Jan 87 – Jul 87		7	0.7	Oct 86 – Aug 87		11	0.7
Feb 88 – May 88		4	1.4	Jan 88 – May 88		5	1.6
Nov 88 – Jul 90		10	1.9	Nov 88 – Jul 89		9	2.1
		11	1.1	Oct 89 – Jun 90		9	1.6
Dec 90 – Apr 91		3	0.2	Nov 90 – Apr 91		6	1.1
	2	1.1					
May 92		1	0.5	Feb 92 – May 92		4	1.0
May 93		1	0.1	Feb 93 – May 93		4	0.6
Apr 94 – Jul 94		4	0.2	Jan 94 – Aug 94		8	0.5

	NSM	ALT 2
Approx. Total Months of Dry Conditions	128 months of 372	176 months
Number of Dry Events	24	28
Approx. Mean Duration	5 months	6 months
Approx. Maximum Duration	21 months	19 months
Approx. Minimun Duration	1 month	1 month
Approx. Mean Depth Below Ground During Dry Events	0.9 feet	1.2 feet

H. Big Cypress Subregion

Note: In all cases targets were conditions predicted by NSM4.5.

Performance Based Comments:

Using the South Florida Maps, Annual Average Hydroperiod Differences relative to NSM were generally similar among the 2050 Base and all of the alternatives, but there were some important differences between them and the 1995 Base. In the 1995 Base, much drier areas were located in the westernmost 2-3 columns of the model, and along the northern boundary of the Big Cypress and the northeast corner of the Big Cypress region. The cells along the western boundary have a definite problem, probably associated with NSM. NSM hydroperiods are way too long, given what is known about the area, so these columns have been excluded from most of the performance measures or evaluations. The drier northern boundary cells could have either a boundary problem or be an effect of upstream alterations. Enough is not known about the area to sort out these possibilities at this time. The northeast Big Cypress is severely drained, probably because of the large canals in the area. There were also somewhat drier-than-NSM conditions in two areas: one is along the southeast boundary of the Big Cypress below Tamiami Trail; and the other extends from the north end of L-28 southwest to Tamiami Trail.

Annual Average Hydroperiod Differences relative to NSM for the 2050 Base and all alternatives still show the much drier conditions along the western and northern boundaries and in the northeast corner of the Big Cypress that were present in the 1995 Base for the same

reasons. In the non-1995 Base simulations, there are only small differences from NSM along the southeast edge of the Big Cypress below Tamiami Trail. For the 2050 Base and Alternative 1, these differences are mostly drier. For the Starting Point and Alternative 2, these differences are scattered and are both wetter and drier. In all of the non-1995 Base simulations, the drier conditions that extend southwest from the north end of L-28 to Tamiami Trail are more severely drier than in the 1995 Base simulation.

Relative to the 2050 Base, there were no hydroperiod benefits / impacts in the Big Cypress from the Starting Point, Alternative 1 or 2 scenarios.

None of the three base or three alternative scenarios showed Ponding Depth Differences when compared to NSM conditions. The only exception might be along the southwest corner, which might be an effect of the Barron River Canal along Route 29 or more probably is an effect of being located along the model boundary. However, relative to NSM, Ponding Depth Differences in the lower portion of WCA-3A along the preserve that are present in the 1995 Base, do not exist in the 2050 Base or any of the Alternatives. This would suggest that L-28 does not affect water levels under scenarios other than the 1995 Base.

Relative to NSM, there are no real Peak Stage Differences among the 2050 Base, Starting Point, and Alternative 1 and 2 scenarios that are important to the Big Cypress. What differences there are, are minor or probably model boundary effects.

Relative to the 2050 Base, there are no Peak Stage Differences in the Big Cypress among the 2050 Base-Sea Level Rise, Starting Point, or Alternative 1 or 2 scenarios. Alternative 1 makes the south end of WCA-3A slightly drier and its north end slightly wetter, which should produce better conditions adjacent to the Big Cypress and could reduce any effects L-28 may be having on Big Cypress water levels. These differences are not present in Alternative 2.

Relative to the 1995 Base, again there are no Peak Stage Differences in the Big Cypress among the 2050 Base, Starting Point, and Alternative 1 and 2 scenarios. The most important change has to do with lowered water levels in the southeastern half of WCA-3A, which again reduces the influence of L-28 on Big Cypress water levels. This is primarily accomplished in the 2050 Base simulation, but there is some additional improvement in Alternative 1. There is a very small increase in peak stage in the southeastern portion of the Big Cypress in the 2050 Base and an additional small increase in Starting Point and Alternative 1. This effect is further increased in Alternative 2 and is largely a result of changes in flows to the Everglades.

Relative to the Starting Point, there were no Peak Stage Differences in or near the Big Cypress for Alternative 2. Relative to Alternative 1, there were no Peak Stage Differences in the Big Cypress for Alternative 2. However, the southern end of WCA-3A and the southeastern edge of the Big Cypress were slightly wetter in Alternative 2.

In looking at Indicator Regions, with the exception of the two upland pines (Indicator Regions 32, 33) and West Slough (Indicator Region 13), for all of the preserve Indicator Regions, the non-NSM simulations were all similar to one another and water levels were lower than those in the NSM. The upland pine water levels were similar between all of the simulations

including NSM. West Slough water levels were more variable among the simulations, and were consistently higher than NSM water levels. The remaining Indicator Regions varied in being sometimes to consistently lower, and from slightly to much lower.

Those that were much lower were the two Indicator Regions 34 and 35 along the western boundary of the model. However, they, particularly region 35, are probably much lower primarily because of problems with NSM hydroperiods being much longer than they should be in the westernmost two (three?) columns of cells, given what is known about the current and historic plant communities in these areas.

The upland pine Indicator Regions 32 and 33 showed no real differences among the simulations. The Robert Lake Strand Indicator Regions 40-44 south of Tamiami Trail showed little difference among the simulations. They all responded similarly.

The Indicator Regions along the eastern portion of the Big Cypress indicated differences between NSM and all of the other simulations, specifically lower water levels than were predicted by NSM. These included the area from Mullet Slough (#31, #38, #39) south through Raccoon Point (#45) to the jetport area (#6, #37). The Mullet Slough sites could be affected by upstream activities or possibly backwater effects of water management in the WCAs. Water levels as predicted by NSM and other simulations for Mullet Slough Indicator Regions 38 and 39 were more similar during the period 1980-93 than before or after this period. Raccoon Point and the jetport could be affected by the management of L-28 and adjacent WCA-3A.

The West Slough (Indicator Region 13) showed greater similarity between NSM and the 1995 Base than between either of them and the other simulations. The similarity between NSM and the 1995 Base tended to break down somewhat after 1985. Water levels in all of the non-NSM and non-1995 Base simulations were quite similar, and were frequently higher than NSM, particularly in the dry season.

In the Big Cypress National Preserve Cell R20C13 is part of Indicator Region 13, and is adequately described above. In Cell R17C13 all simulations track each other well, although NSM water levels are frequently slightly higher. The 2050 Base, Starting Point, and Alternative 2 water levels were more similar to each other than to Alternative 1, and they were even less similar to the 1995 Base.

As predicted by all base and alternative scenarios, hydroperiods in less than half of the North Big Cypress National Preserve matched NSM conditions. Most of these acres had 30-90 day shorter hydroperiods, but for about 10% of the acres, hydroperiods were 90-180 days shorter. There were no differences among any of the scenarios, indicating that none of the components were influencing this area. It is uncertain at this time whether these hydroperiod differences from NSM conditions are a result of model characteristics in this area or upstream hydrologic alterations.

In the South Big Cypress National Preserve there are small differences among the scenarios, but only about 10% of the area is different from NSM, and most of those deviations are only 30-90 days longer or shorter. The longer-than-NSM hydroperiods appeared to be in the

area adjacent to the Everglades, while the shorter-than-NSM hydroperiods were southwest of the north end of L-28.

Average overland flows to the Gulf of Mexico in the Big Cypress show substantial spatial variability, although within a geographic area, flows predicted by the various base and alternative scenarios were similar to one another but different from the NSM. In western Big Cypress National Preserve, dry season flows were similar among all scenarios, while NSM had about 50% more flow than the other scenarios during the wet season. In eastern Big Cypress National Preserve, both wet and dry season flows were about 50% higher in NSM than all other scenarios. In the Lostman's area, next to the Everglades, flows are substantially higher among all base and alternative scenarios during both the wet and dry seasons than for NSM. There is also more variability among the scenarios in the Lostman's area than for either of the other flow cross-sections, because of the greater amount of hydrologic manipulation in the Everglades than in the Big Cypress.

Performance Measures and Indicators Used:

1. Hydroperiod Distribution Maps
2. Hydroperiod Improvement Maps
3. Hydroperiod Differences Maps
4. Ponding Depth Maps
5. Ponding Depth Differences Maps
6. Peak Stage Differences Maps
7. Indicator Regions in or near Big Cypress (13, 31-45)
    - Weekly Stage Hydrographs
    - Weekly Stage Duration Curves
    - Temporal Variation of Stage
8. Big Cypress National Preserve, Cells R20C13 and R17C13
    - Stage Hydrographs
    - Stage Duration Curve
9. North and South Big Cypress National Preserve
    - NSM and 2050 Base hydroperiod matches
10. Average wet/dry season flows toward Gulf of Mexico
    - Western Big Cypress National Preserve
    - Eastern Big Cypress National Preserve
    - Lostman's
11. Average monthly overland flows toward Gulf of Mexico
    - Western Big Cypress National Preserve
    - Eastern Big Cypress National Preserve
    - Lostman's

Recommendations:

1. The effects of removing the L-28 levee would be interesting to see, based upon the effects observed in Indicator Regions and overland flows along the eastern portion of the preserve. Also, given system changes to be made in the 2050 Base, hydroperiods, ponding depths, and

peak stages along the levee do not appear to be influenced by its presence after the 1995 Base.

2. In order to have more complete coverage of the Big Cypress that could assist with understanding the spatial distribution and thus maybe the causes of differences in the alternative simulations, the following four Indicator Regions should be added using the same performance measures as for the current Big Cypress Indicator Regions:
   R37-38, C5-6 (4 cells)
   R38, C10-11) (2 cells)
   R34-35, C6-7 (4 cells)
   R28-29, C4-5 (4 cells)
   R37-38, C14 (2 cells)
3. The following Indicator Regions could be collapsed into a single region:
   Indicator Regions 40-44 (R24, C8-11, and R25, C10) could be collapsed into one region with the ID "Roberts Lake Strand."
   Indicator Regions 32-33 (R29-30, C8) could be collapsed into one region with the ID "Upland Pine."
4. Try to determine if differences in hydrology from that predicted by the NSM for the northern portion of the Big Cypress National Preserve are a function of characteristics of the model (e.g., boundary conditions) or are a result of upstream hydrologic alterations.

I. WATER QUALITY

Performance Based Comments:

In terms of mean phosphorus concentrations within the Everglades Protection Area, Alternative 2 did not differ significantly from Alternative 1 or from the 2050 Base condition; however, the subteam cautions that the principle reason for this is the structural inflow concentration assumption underlying the model used to simulate future phosphorus concentrations. Specifically, all structural surface water discharges into the Everglades Protection Area (including new components being evaluated by the Restudy) are assumed to meet the default criterion established by the Everglades Forever Act (10 ppb). This assumption, while legally valid, fails to clarify the land use and construction and operation costs and hydrologic demands of future treatment facilities necessary to achieve the requirements of the Everglades Forever Act. Furthermore, because of the multiple uses of several of the components (M1, 01, P2, S1, V2), it is difficult to calculate the annual volumes of water discharged out of those components into the Everglades Protection Area. This calculation and underlying assumptions about phosphorus forms, concentrations, and loads are key to determining future treatment requirements.

For Lake Okeechobee, Alternative 2 was improved over Alternative 1 for both phosphorus in-loads (inflows to the lake) and out-loads (outflows from the lake). This is assumed to be a result of the phosphorus reduction function of component W2 (Taylor Creek/Nubbins Slough Reservoir and STA). However, the performance of Alternative 2 is approximately equivalent to the 2050 Base condition for these two performance measures. The subteam concludes that this result (no change in phosphorus out-loads compared to 2050 Base conditions) is caused by the overall reduction in lake water volume simulated by the model. Due

to the existing in-lake phosphorus load and phosphorus cycling processes, in-lake phosphorus loads are not expected to diminish significantly during the model simulation period.

Performance Measures Used:

Note: The subteam used performance measures and indicators developed for the South Florida Water Management Model, Everglades Water Quality Model, and the Lake Okeechobee Water Quality Model. Additionally, the subteam created a summary table showing the size of the plan components and the source of water delivered to each plan component, receiving water bodies for each component, classification and special status, ambient phosphorus concentrations (if known), and phosphorus treatment efficiency, as well as observations about the hydrologic characteristics of the components. A copy of the table appears at the end of this section.

Specific Performance Measures and Indicators Used:

South Florida Water Management Model

1. Stage Duration Curves and Stage Hydrographs for all of the reservoirs included in this alternative plan (North Reservoir, Taylor Creek/Nubbins Slough Reservoir, St. Lucie Reservoir, Caloosahatchee Reservoir, EAA Reservoir, Site 1 Reservoir, C-11 Reservoir, C-9 Reservoir, Central Lakebelt Reservoir, Bird Drive Reservoir)

Everglades Water Quality Model

2. Mean grid cell water column phosphorus concentrations within the Everglades Protection Area
3. 14-station (per Settlement Agreement) mean phosphorus concentration within Loxahatchee National Wildlife Refuge

Lake Okeechobee Water Quality Model

4. Lake Okeechobee volume
5. Cumulative phosphorus loading into Lake Okeechobee
6. Cumulative phosphorus load in discharges from Lake Okeechobee
7. Difference from 2050 Base concentrations for total phosphorus, chlorophyll-a, and blue-green algae

Recommendations:

1. The storage reservoirs should be operated to optimally capture phosphorus contained in inflows and remove phosphorus from outflows. To the extent that phosphorus is a surrogate for other pollutants, optimal operation of these facilities for phosphorus removal will contribute to additional downstream pollution load reductions. The subteam's present recommendation for optimal operation is to maintain at least 2.5 ft depth in the reservoirs, with a minimum hydraulic retention time of 21 days prior to discharge (when depths fall below 2.5 ft; note: this differs from the subteam's recommendation contained in the AET's draft December 11, 1997 report). The subteam recognizes that during dry periods it is likely that all of the reservoirs will dry down; however, upon rewetting, the 2.5 ft depth / 21 day minimum hydraulic retention time criteria are the operational targets.

Subteam Issues:

1. Restudy components must meet State and Tribal water quality standards, as appropriate. In particular, increased flows to the Everglades Protection Area (over that which is in the 2050 Base condition, i.e. Everglades Forever Act fully implemented) must meet the yet-to-be-established numeric phosphorus criteria for the EPA (default concentration = 10 parts per billion). The technology (and hydrologic demands, if any) required to achieve this standard has not yet been determined. Furthermore, it can be reasonably assumed that the technology (and concurrent land and hydrologic demands) will vary for Restudy components, depending upon location. Component design should continue to take into account current and future land uses in the vicinity of the components and the estimated land acquisition, construction, and operations costs to assure that water quality treatment facilities necessary to meet water quality standards are included in the final design. Additionally, treatment costs may not be limited to just those necessary to achieve surface water standards. Restudy components capable of polluting groundwater (ASR, discharges in the vicinity of underground drinking water sources) must include treatment necessary to achieve ground water and drinking water quality standards prior to introduction of discharges into the ground water.

2. The subteam does not expect to observe a recovery of Lake Okeechobee during the simulation period for the model(s). Therefore, the long-term benefits of treatment facilities and wetlands restoration in the lake watershed are not readily observable in the water quality performance indicators which are available to evaluate the affect of the Restudy on the lake. Although modeling results may lead the Restudy Team to empirically conclude that there are no water quality benefits achieved by including water quality treatment features in the Restudy components when compared to 2050 Base conditions, the subteam intuitively concludes that such projects and facilities will have long-term water quality benefits beyond the planning horizon for the Restudy.

3. Although the subteam concurs with the method for determining mean phosphorus concentration values in the Taylor Creek/Nubbin Slough basin (528 ppb), additional information is needed about the design and operation of the STA proposed for that basin. While it is understood that more detailed information about the design and operation of this component would occur in future detailed design work if this component is included in the final comprehensive plan, it is noted that the STA is assumed to achieve an 80% reduction in basin loads and concentrations prior to discharge to Lake Okeechobee (this efficiency is at the upper end of the range of phosphorus reduction efficiency for STAs). Furthermore, the subteam has not determined that 107 ppb is the correct target concentration for discharges to Lake Okeechobee (this concentration will not necessarily contribute to a reduction of ambient lake water column phosphorus concentrations below the current mean concentration of approximately 100 ppb). Additional treatment works may be necessary to achieve target concentrations.

4. Components K2, X2, and Y2 involve increasing the amount of water contained within the West Palm Beach Water Catchment Area. This involves collecting runoff from the L-8, C-51, and C-17 watersheds (Class III waters), and directing it via the M-Canal and C-18 Canal to the Catchment Area. The C-18 Canal, M-Canal, and the Catchment Area are all Class I

waters. To receive water quality certification under the Clean Water Act, Restudy components which create new surface waters discharges into Class I waters would have to discharge water of sufficient quality to assure that the Class I use classification is maintained. To further evaluate future treatment requirements, if any, ambient pollutant loads and concentrations within the watersheds would have to be quantified and compared against minimum, general, and Class I surface waters criteria contained within Florida Administrative Code Rule 62-302.

5. The subteam is concerned about the proximity of the Central Lakebelt reservoir (component S-1) to Dade County's Northwest Wellfield and the assumptions underlying the operation of this facility. This component as designed assumes no horizontal transmissibility (i.e. surface water within the reservoir would not interact with ground water within the wellfield's cone of influence). The potential for horizontal transmissibility should be further evaluated if this component remains in the comprehensive plan. Furthermore, the design of this component does not take into account potential vertical transmissibility and any gradients that could be created causing chemical constituents within reservoir waters to migrate out of the reservoir into the cone of influence of the wellfield. The reservoir receives surface water discharges from at least four sources (North New River, west C-11 basin watershed, west C-9 basin watershed, and the C-6 basin watershed). Ambient pollutant loads within these waters have not been quantified; however, the subteam reasonably assumes that concentrations of constituents contained within surface water runoff do not at all places and times meet the primary and secondary ground water criteria as specified in Florida Administrative Code Rule 62-550. If this component remains in the comprehensive plan, and if subsequent investigations determine that the design and operation of the component could adversely affect water quality within the cone of influence of the Northwest Wellfield, it may become necessary to include the costs to design and construct additional treatment works (including land acquisition, if necessary) in the comprehensive plan. Alternately, the in-ground reservoir could be relocated (based on geotechnical investigations) to assure that the facility is outside of the cone of influence of the Northwest Wellfield.

6. Component D2 includes 220 MGD of ASR of Lake Okeechobee and Caloosahatchee basin runoff. It is unlikely that untreated surface water would meet primary and secondary ground water standards, necessary for injection into the aquifer. If this component remains in the comprehensive plan, the costs to design and construct treatment works (including land acquisition, if necessary) necessary to treat surface water to ground water standards would have to be included in the comprehensive plan.

7. The Lake Okeechobee Water Quality Model is now fully calibrated and verified and linked to the Restudy website (look under "Other Models"). Although several performance indicators have already been developed for the Lake Okeechobee model, the subteam expects to develop additional performance indicators (e.g. wet and dry year concentrations of phosphorus, chlorophyll-a and blue-green algae).

8. The Everglades Water Quality Model (EWQM) is not yet ready to be linked to the Restudy website, although the subteam is using model output to evaluate alternative plan performance. It is expected that the model results will be available via the Restudy website

by mid-February. The subteam has proposed several phosphorus concentration performance measures, many of which are still being coded. Additionally and most importantly, the subteam has requested that cumulative structural and non-structural phosphorus loads into the Everglades Protection Area be coded as a priority performance indicator. The subteam's intent is to identify additional phosphorus loads into the Everglades Protection Area created by Restudy components, which would enable plan designers to design and estimate the costs to provide treatment necessary to meet water quality criteria.

ALTERNATIVE 2 COMPONENTS WATER QUALITY ANAYSIS

Component	*Source*	*Class OFW*	**[P] ppb**	*Receiving*	**Class OFW**	**[P] ppb**	**Max. Volume**	**P Treatment Efficiency**	**Comments**
A1 N. Res.	Kiss. WS	III N	?	Lake O.	I N		200,000 af	?	Dry 75% of time
B2 St. Lucie Res.	Lake O. St.L WS	I/III N	100 ?	St. Lucie River	III N		40,000 af	?	Below 2 ft. 90% of time
C1 St. Lucie Est. Deliveries	Lake O. St. L. Res.	I/III N	100 ?	St. Lucie Estuary	II/III Y			0 (Lake O.) ? (res.)	Alt. 2 deliveries 3X above target; better than FB
D2 Caloos. Res.	Lake O. Caloos. WS	I/III N	100 ?	C. River	I/III Y		160,000 af	?	C. Riv. In Lee Co. is Class I
D2 Caloos. ASR	Lake O. Caloos. WS	I/III N	100 ?	C. River	I/III		70% of 220 MGD = 172,914 af	0 – any treatment prior to ASR?	See above. GW regs apply to ASR. Multi-year capability.
E1 Caloos. Est. Deliveries	Lake O. Caloos. Res.	I/III N	100 ?	Caloos. Estuary	III/II Y			0 (Lake O.) ? (res.)	Alt 2 deliveries still 2X above target; slightly improved over FB
F1 Lake O. Reg Schedule	Lake O.	I	100	St. L & Caloos. Rivers, EAA, WCAs.	I/III			0	No add'l WQ Benefits assumed from Reg. Schedule
G2 EAA Res.	Lake O EAA runoff	I/III/IV(?) N	100 120	WCA 3 (via STA 3/4)	III/IV N	10	240,000 af	?	Below 2 ft. 80% of time.
H1 E'glades Rain-driven Operations	ECP/ STAs	III N	10	WCAs	III Y	10		N/A	Need to know increased volume to calculate treatment area size and cost.
I1 WCA3B/ ENP Improved Conveyance	WCA 3B	III N	10	ENP	III Y	10		N/A	Add'l S-355s, Bridging Tamiami Trail

Component	*Source*	*Class OFW*	**[P] ppb**	*Receiving*	**Class OFW**	**[P] ppb**	**Max. Volume**	**P Treatment Efficiency**	**Comments**
J									Not in Alt. 2
K2 L-8 Project	L-8, C-51, C-17 Basins	III N	?	M Canal, WPB CA Lox. Slough	I Y		Need to know this amount.	?	
X2 C-17 B'pumping	C-17 WS	III N	?	M Canal, WPB CA (via STA)	I		1,224 af	?	No hydrologic specs on STA; STA must achieve Class I wqs
Y2 C-51 B'pumping	C-51W WS	III N	?	WPB CA	I		7,200 af	?	No hydrologic specs on STA; STA must achieve Class I wqs.
L2 Coastal Wellfields	GW							N/A	Operational change; GW regs. Apply
M1 Site 1 Res.	Hills. Canal	III N	?	Hills. Canal WCA2A	III N	? 10	9,360 af	?	How much to WCA-2A? Res. Below 2 ft 40% of time.
N2 WCA 2B Levee Seepage Management	WCA 2B	III N	10	N/A	III N	10	N/A	N/A	Levee seepage reduction only.
01 WCA3A/B Levee Seepage Management	WCA 3A/B	III N	10	WCA3A/B	III N	10		N/A (?)	Buffer marsh seepage wq = WCA seepage wq? Buffer adj. to U.S 27.
P2 NNR Div. Canal & C-11 Treatment Fac.	NNR WCA 2B	III N	? 10	WCA3A	III N	10	6,400 af Need to know vol. of NNR canal H20 not orig. in WCA2B.	Minimal if operated as indicated by stage duration curve. ?	Res below 2 ft. 80% of time.
Q1 WC-11 Diversion Canal	WC-11 WS	III N	?	Lakebelt Res.	III N Y (ENP)			N/A	Component of WC11 WS H20 to be delivered to L-30/NESRS via Lakebelt Res.

Component	*Source*	*Class OFW*	**[P] ppb**	*Receiving*	**Class OFW**	**[P] ppb**	**Max. Volume**	**P Treatment Efficiency**	**Comments**
R1 C-9 Res.	WC-9 WS	III N	?	C-9 Lakebelt Res.	III N Y (ENP)	11	10,000 af Need to know how much from WC-9 WS could be delivered to L30/NESRS	?	Res. below 2 ft 60% of time. C-9 res. does not discharge directly to E'glades.
S1 Lakebelt Res.	NNR WC-11 WC-9 C-6	III N	?	L30/NESR D-B Lev. Canal, S.Creek Canal, C-6	III N Y(ENP)	? 11	80,000 af Need to wq & vol delivered to NESRS	?	Pot. Impacts on NW Wellfield;
T1 C-4 Struct.	C-4	III N	N/A	C-4	III N		N/A	N/A	WCA3B Seepage control
U2 Bird Drive Res.	WC-4 WS L-31N	III Y(L-31N)	? 10	C-4 L-31N (seepage)	III N Y(ENP)	? 10	11,508 af Need what component is of lower wq	?	Below 2 ft 100% of time
V2 L-31N Levee Seepage mgt	ENP	III Y	10	ENP	III Y	10	N/A (backpump wet season seepage)	N/A	
W2 T. Creek/ N. Slough Res/STA	T.Cree k N. Slough WS	III N	528	Lake O	I N	100	50,000 af	528 → 107 ppb. Is this reasonable based on size, conc., & load?	100% of run off less than 50,000 af treated in STA. Res dry 70% of time (STA dry? = P source)
AA2 Add'l S-345s	WCA 3A	III N	10	WCA 3B	III N	10	N/A	N/A	Add'l conveyance capacity only.
TOTAL							**988,606 af**		

LEGEND:

WS = Watershed
ASR = Aquifer Storage & Recovery
ECP = Everglades Construction Project
STA = Stormwater Treatment Area
WPB CA = West Palm Beach Catchment Area
Y = Yes
N = No
W = West
WCA = Water Conservation Area
D-B = Dade-Broward Levee

J. ATLSS/Threatened and Endangered/Keystone Species

Performance Based Comments:

For the Cape Sable seaside sparrow, wading birds and white-tailed deer, ATLSS outputs for Alternative 2 continue to be limited to Breeding Potential Indices (BPIs). Individual-based simulations for these species are under development. Additional outputs on total fish abundance and fish prey base for wading birds are available for this simulation. An important difference in the Alternative 2 output vs. previous outputs is the use of high-resolution hydrotopography derived from the SFWMM outputs rather than use of the raw SFWMM output. This difference in input data makes quantitative comparisons of Alternative 2 outputs to Alternative 1 outputs and/or 1995 Base outputs impossible and makes qualitative comparisons questionable. For this reason, only comparisons of Alternative 2 vs. 2050 Base are reported below.

Because ATLSS outputs provide estimates of potential breeding or potential prey base, they provide only predicted trends in habitat suitability and can not be used as a measure of threat/recovery for species. Therefore, quantitative performance measures are difficult to develop based on current ATLSS outputs.

Fish :

The ATLSS fish model predicts that, due to overall wetter conditions in WCA-3B and south of Tamiami Trail, Alternative 2 hydrologic conditions will produce average fish abundances consistently higher than those expected for 2050, particularly in Shark River Slough and WCA-3B. This is also true when only prey-sized fish at appropriate wading bird foraging depths are counted.

Wading Bird Breeding Potential Index:

Consistent with the fish model output, Alternative 2 would result in a slight improvement in breeding potential for wading birds over those expected for 2050 under most conditions due to dryer conditions in the deeper WCAs and wetter conditions south of Tamiami Trail, particularly in Shark River Slough and its peripheral wetlands.

White-tailed Deer Breeding Potential Index:

Alternative 2 will slightly reduce the generally poor breeding conditions for white-tailed deer in most of the modeled area as compared to 2050, particularly in years with average to above average rainfall. For those few areas with high deer breeding potential (Long Pine Key and surrounding short hydroperiod marsh), there is little difference between Alternative 2 and the 2050 Base.

Cape Sable Seaside Sparrow Breeding Potential Index:

Differences in sparrow breeding potential for Alternative 2 and the 2050 Base are slight; however, for most years, the 2050 Base is more conducive to successful breeding in areas vulnerable to flooding, while Alternative 2 sometimes provides better conditions in the northwestern parts of western habitat areas. The western subpopulations continue to be most sensitive to year-to-year changes. Alternative 2's increased flows to northeastern Shark River Slough appear to provide slight improvements in breeding potential in the western habitat areas.

Performance Measures and Indicators Used:

1. Breeding Potential Indices for the Cape Sable seaside sparrow, white-tailed deer, and generalized wading bird guild
2. Fish productivity model

Recommendations:

1. Predicted breeding potential for the Cape Sable seaside sparrow continues to be a potential concern. Any actions that would further decrease late wet season and dry season flows west of Shark River Slough may improve breeding potential or the particularly vulnerable western sparrow subpopulation. Once all measures to move water east have been exhausted, the ADT could try adding total removal of L28 to see what happens.
2. Improvements in the wading bird BPI could result from reducing the number of hydroperiod reversals occurring during the December 15 to May 15 breeding.
   period.

Subteam Issues:

1. Several AET members questioned results predicted for the western sparrow subpopulation because the still longer hydroperiods in the western subpopulation area that appear to be necessary in order to meet NSM would lead to further declines in the sparrow BPI. These counterintuitive results could result from error in the elevation data used in the SFWMM, a mis-match of suitable habitat areas as defined in ATLSS vs. as defined by observations of sparrow breeding activity, or error in NSM. The subteam hopes to resolve some of this uncertainty through development of a new indicator region specific to the western subpopulation. The subteam is exploring possible ways to check the validity of elevation data for the western subpopulation area.

2. Could the fish model and wading bird BPI be interrelated over the next few months, in keeping with the long-term goal of ATLSS to link trophic levels? Doing this may address some criticisms of the wading bird model.

3. Can the white-tailed deer BPI be combined with existing panther radiotelemetry data to get a rough index of the proportion of the panther's prey base that is predicted to be affected by the alternatives? The subteam suspects this will prove to be a small portion of the panther's prey base, but it would be a useful calculation if it can be done before May. The subteam will work on this.

4. Rob Bennetts reports that code has been written for an interim snail kite indicator. This indicator should be available by the end of January, in time for Alternative 3 or 4.

5. The subteam has developed a performance measure for crocodile habitat suitability tied to the salinity predictions for the mangrove zone developed by Steve Davis.